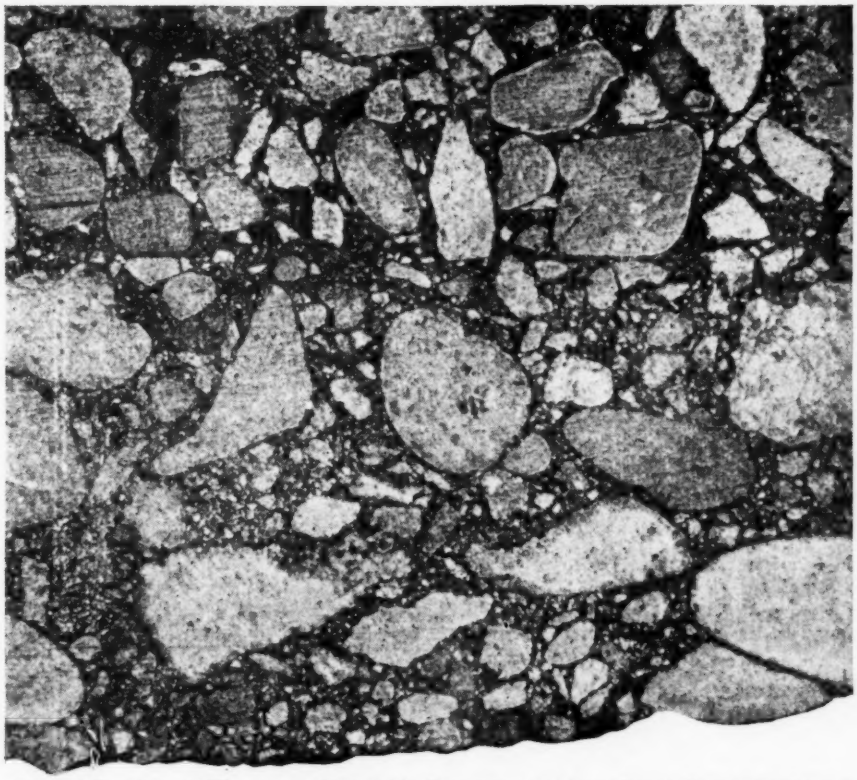
Warrenite-Bitulithic Pavements and Roads Laid on Bituminous Concrete Base

The Proof of the Pudding



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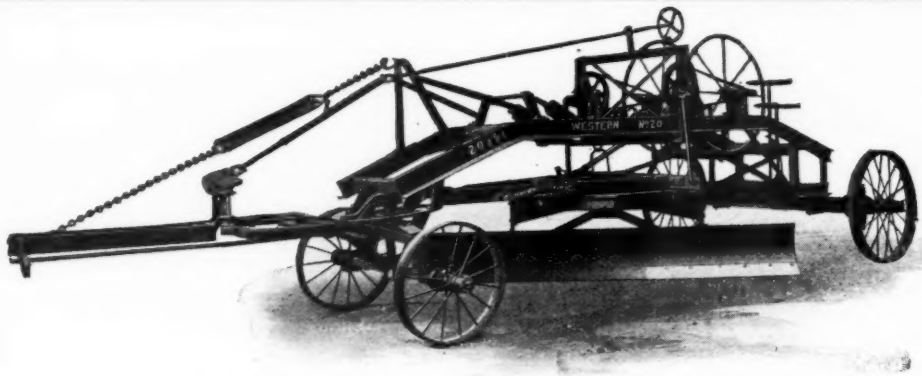

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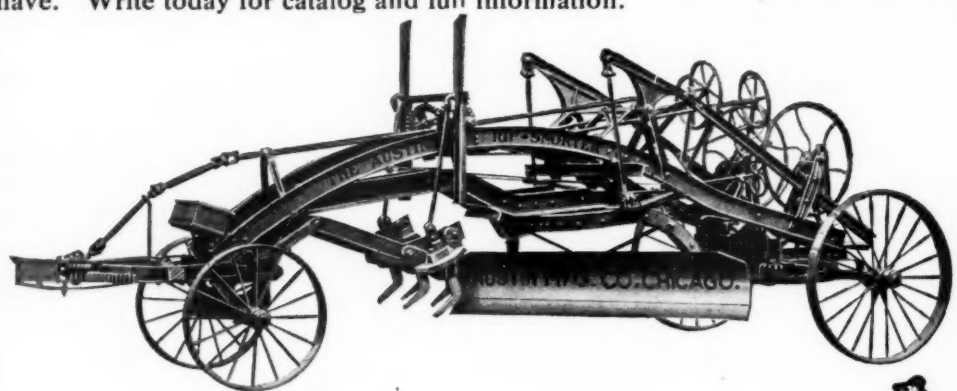

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Vol. LX JANUARY, 1921 No. 1

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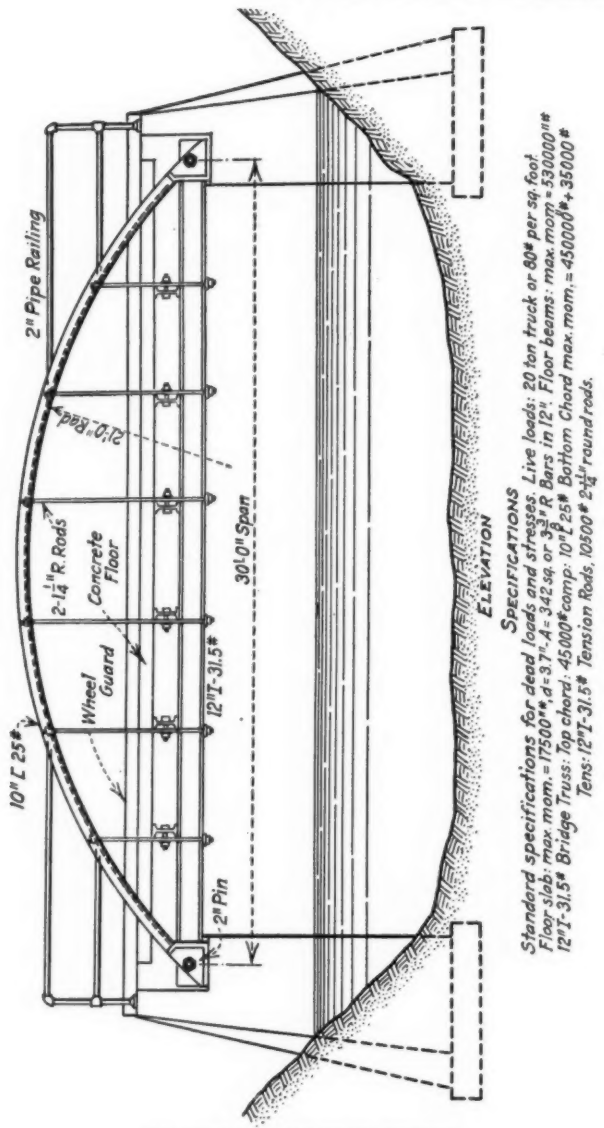
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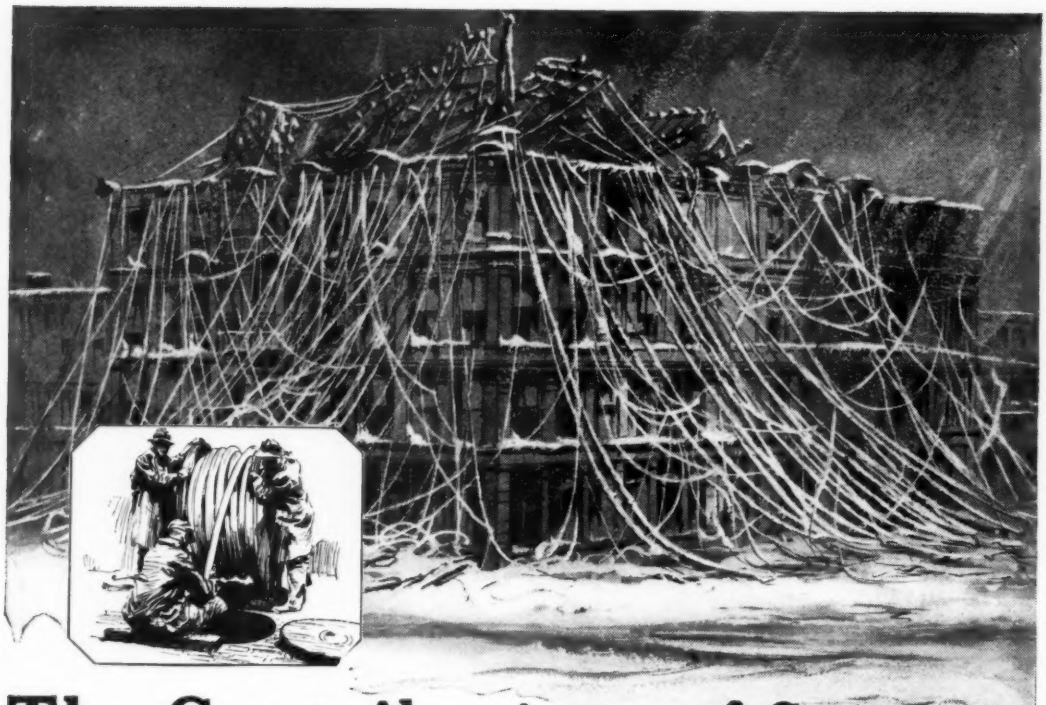

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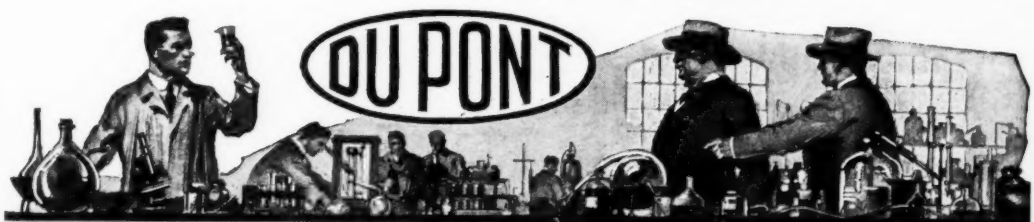

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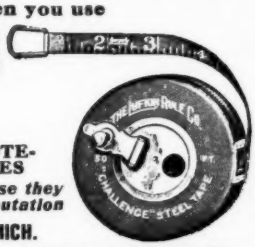

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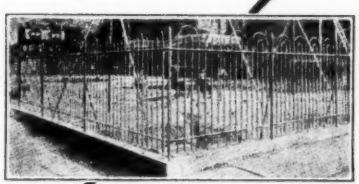

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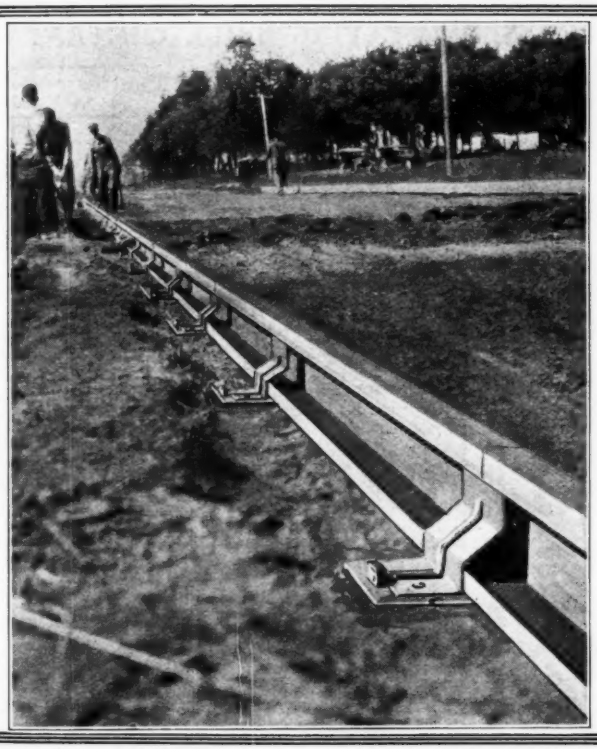

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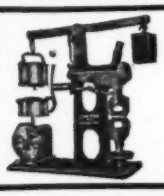

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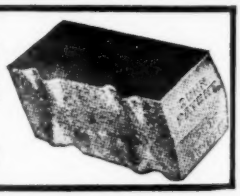
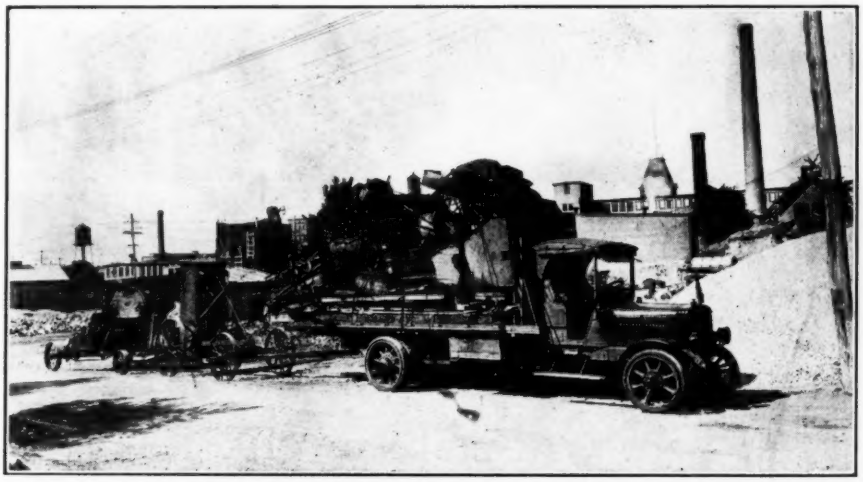


MOTOR TRUCKS

Motor Trucks as Operated in Municipal and County Service and in Highway Transportation



ACME 5-TON TRUCK, WITH TWO TRAILERS, HAULING CONTRACTOR'S ROAD BUILDING OUTFIT 35 MILES IN SIX HOURS.

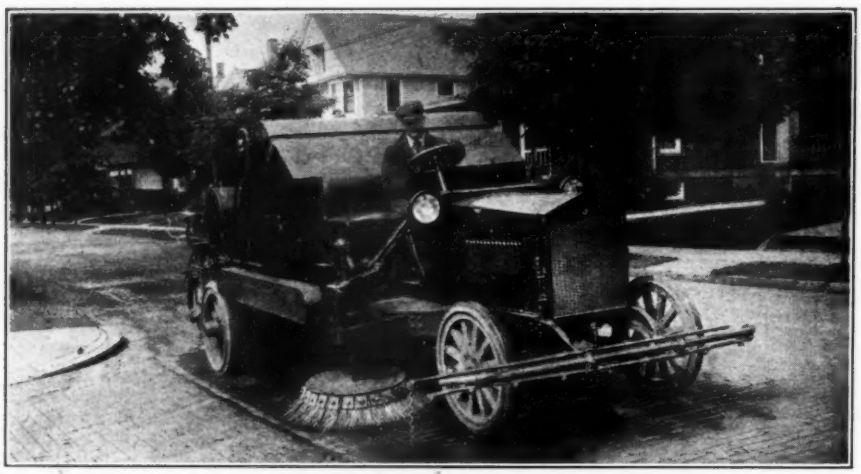
Motor Truck Operation and Accounting LXV

Moving Road Building Outfit by Truck

The view on the title page of this truck section illustrates what a 5-ton motor truck can accomplish when necessity arises. Simpson Brothers' road building outfit, consisting of concrete mixer, boiler, machinery and tools, loaded on two railroad flat cars at Marion, Mass., were wanted in a hurry at the city of Brockton, 35 miles away, to finish a street paving project. Shipment by rail would have meant a delay of several days, so it was decided to haul the outfit by truck. The trip was made in less than 6 hours.

The Austin Motor-Driven Pick-Up Sweeper

An accompanying view illustrates the Austin motor-driven pick-up street sweeper recently put on the market by the Austin-Western Road Machinery Co. This sweeper is performing so well that even the expectations of the manufacturer are exceeded. This piece of equipment not only sweeps the streets cleaner than can be done with either hand labor or horse-drawn equipment, but the cost of doing the work is about 50 per cent. less than by the old-style methods.



THE AUSTIN MOTOR DRIVEN PICK-UP SWEEPER.

Duplex Trucks Meeting with Success in Contracting Fields

The Louisiana State Highway Department finds the Duplex 4-wheel drive truck highly satisfactory, both in performance and cost of operation and maintenance. The Duplex truck is also giving satisfaction in Bridgeville, Pa., where heavy loads and indifferent roads are the rule. Polk county, Oregon, uses Duplex trucks in road building. They say that no matter how hard the work or what the road conditions, nothing ever stops a Duplex. Officials of Lee county, Iowa, use Duplex trucks in bridge building work. The A. B. Crump Construction Co., of Macon, Ga., are doing work with one Duplex in a day and a half of time which would take 6 mules a total of 15 days.

A company of street surfacers of Denver, Colo., are using Duplex trucks to replace several other makes of trucks up to 7 tons capacities, including some 75 to 90 caterpillar tractors. A Duplex truck in the service of Genesee county, Michigan, is in daily operation. Figured on a team-work basis, they are earning as high as $50 a day. Ingham county, Michigan, is now operating six Duplex trucks for grading and gravel hauling. It is reported that each truck more than pays for itself in one season by its saving over team haulage.

The officials of Butler county, Iowa, owners of a Duplex truck, report that their haulage costs have been cut square-

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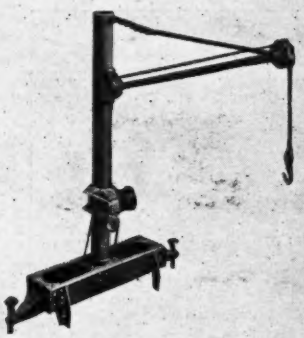

Cranes for Motor Trucks

Mead-Morrison are known as builders of practical, time-saving hoisting and loading apparatus for motor trucks.

We are now producing the Mead-Morrison Motor Truck Crane. The one illustrated here is particularly adaptable for loading bales of wool, cotton, lumber—short lengths, crates, boxes and general merchandise. Its time- and labor-saving value is remarkable.

In addition to the crane shown above, we make a heavy-duty Single Line Motor Truck Crane suitable for general use, including lifting magnet and grab bucket work.

Our representative will gladly call and give you complete details.

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ly in two. A contractor in Portland, Ore., expected two Duplex trucks might be able to move his 26-ton steam shovel. One was enough to not only haul the shovel, but to carry a 3-ton clam-shell bucket besides. Out in Colorado the Duplex is hauling 6 tons on a 5-ton trailer, making 5 return trips daily over a 5-mile course. The advantage of Duplex liberal road clearance is being demonstrated by a firm of road builders in Walla Walla, Wash., who desired a truck capable of operating in the "Blowsand" along the Snake river.

The extensive road building projects which have been in contemplation and development during the past two years will be well under way within the next few weeks, and the resources of road building contractors will be tested to the utmost. Such a condition does not tolerate the use of any but time and labor-saving equipment, especially for the haulage of materials, and the demand for heavy duty motor trucks for this service is going to be larger than the supply. "This particular serviceability of Duplex 4-wheel drive trucks for contractors, road builders and gravel haulers is too well known to require much comment," is the claim of the Duplex Truck Company.

New Hook and Ladder Fire Truck

A new 216-in. wheelbase hook and ladder fire truck, with a 40-gal. chemical tank, has been put into service by the city of Ashland, Wis. This fire-fighting equipment is mounted on a 3-ton FWD chassis. Power is furnished by an unusually powerful type J Wisconsin motor of 5.1-in. bore and 5½-in. stroke. The truck is run at an average speed of 25 miles per hour and has an excess power available for maintaining this speed under poor road and grade conditions.

Because of its 4-wheel-drive principle, which gives it pulling power on all four wheels, enabling it successfully to negotiate soft and muddy roads as well as the heavy snowdrifts of winter, the FWD truck is rapidly winning favor as a fire-fighter through its ability to overcome these conditions.

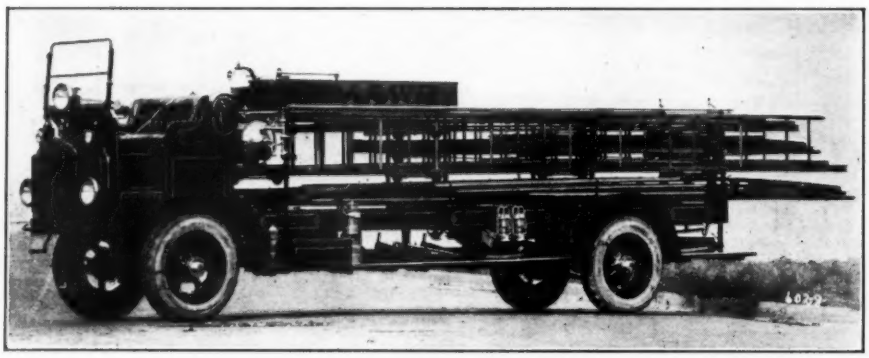
Overloading Big Factor in Road Wear

What is the real cause of excessive road wear? That is a question uppermost in the minds of highway engineers and public road officials at this time. Some contend it is the large capacity motor truck, but government tests and various investigations tend to disprove this theory in the light that to eliminate large trucks would greatly increase the number of small trucks on the road, thereby increasing road wear.

R. E. Fulton, Vice President of the International Motor Company, says it is the practice of overloading, and in a letter sent recently to all Mack truck branches, dealers and salesmen, makes a strong plea to discourage overloading among truck users in the interest of highway preservation.

"Truck overloading is disastrous to both the vehicle and the highway," he says. "If its results were confined to the truck, it might be well to let each individual learn for himself that it does not pay. But unfortunately overloading is one of the principal causes of road wear.

"A motor truck designed to carry a certain tonnage is constructed throughout, including width of tires and safety factors, to handle just its rated load. Any considerable overload gives more than the standard 800 lbs. per inch of tire width and concentrates the load on this small point of contact. Furthermore, the overload is not distributed on all four wheels, but rests entirely on the rear axle, which



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further concentrates the load. Overloading does not materially cut down the speed, and the result is that a higher rate of speed is maintained than should be given to the load, even though properly tired.

"It has been extremely noticeable in sections where the use of large capacity trucks is discouraged that there is a strong tendency to overload small trucks. This is only natural, since the demand for motor hauling service remains the same and practically none can be diverted to other channels. When the smaller vehicle is overloaded, its effect on the road is tremendously magnified, because its springs fail to function properly and the narrow bearing surfaces of its tires concentrate the impact forces so that they are greater than the road is capable of withstanding.

"There is economy both as to road wear and as to truck operating costs in big unit loads, but not when they are carried on vehicles too small to handle them."

Indianapolis Successfully Employs Tractors and Trailers in Hauling Ashes

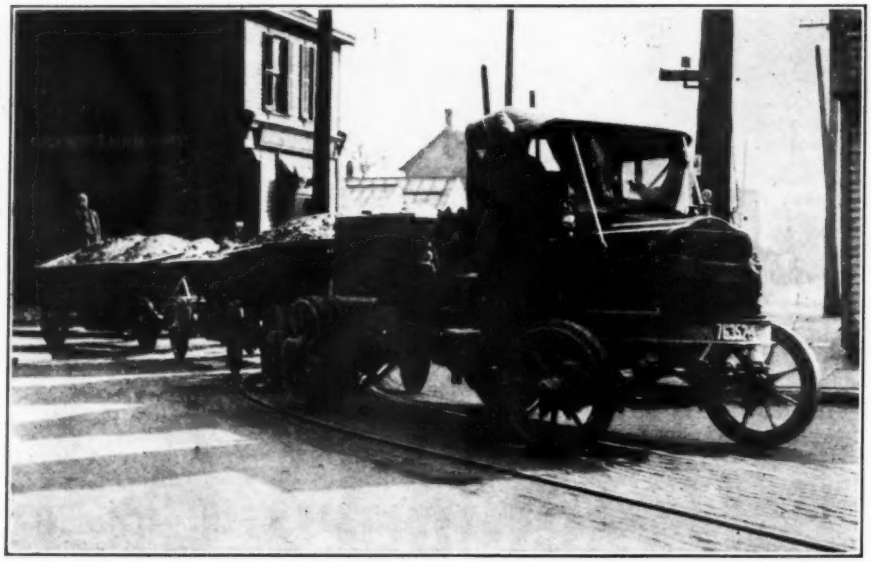
On Oct. 1, 1918, the contract for hauling Indianapolis' ashes expired. The contract had been held by the Indianapolis Hauling Company, which submitted a new bid. Beginning Jan. 1, 1919, it would be worth $84,000 a year and $54 an acre for annexed territory to continue the ash-hauling work for a period of 5 years.

The city decided to purchase four 5-ton White trucks and 25 trailers. This fleet went to work immediately. That was in the winter of 1918-19. Since that time the motor equipment has gone faithfully along, writing itself off the books. During 1919 a total of 115,286 cu. yds. of material was collected and haued to the dumps.

Figuring 7 years as the life of the trucks and trailers, the item of depreciation for 1919 was approximately $8,286. Operating costs (including oil, gasoline, tires, repair parts, labor on trucks and trailers) totaled $12,305. Allowance of 6 per cent. interest on the balance of the cost of the equipment adds $2,784 to the year's total. Then throwing in a pay-roll of $53,063, the total cost for 1919 amounts to $76,439, which, on the basis of 115,286 cu. yds. of ashes collected, gives approximately 66 1/3 cts. as the haulage cost per cubic yard.

But the real advantage of the motorized and city-controlled ash-hauling system is not at once apparent in these figures. Recall that the renewal term proffered by the private contractors was not a flat figure of $84,000, but rather that amount plus $54 an acre for annexed territory. Since taking over its own ash-hauling job the city of Indianapolis has extended its service facilities to a greatly enlarged territory, which, had it been annexed under the terms of the tentative new private contract, would have run the expense of that service very close to $100,000.

Moreover, the city now owns its own equipment and controls its use. Whereas



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Tractors are Offered Subject to Prior Sale.

formerly some sections of the city were neglected at times when the weather was inclement, and complaints were accordingly vociferous and vexing, calls and collections are now made regularly, in fair weather and foul, and complaints have consequently been reduced to a negligible number, according to Mr. Thomas A. Riley, supervisor of Indianapolis' Ash-Hauling Department.

Few Complaints Now

"We used to have to listen to as high as 200 complaints a day," declared Mr. Riley. "Now, thanks to the day-after-day dependability of the tractors, complaints average only 10 a day, a truly remarkable record when you consider that we have 70,000 homes to serve and an intricate maze of alleys to thread."

Perhaps the best indication of the complete satisfaction which motor equipment has given is the authorization made recently by the Board of Public Works and City Purchasing Agent Dwight S. Ritter for the purchase of two additional White 5-ton trucks and a half dozen more trailers.

The old trucks are all in good shape to face their third winter and promise to go on indefinitely, according to Mr. Ritter, who characterizes the showing they have made thus far as "an unanswerable argument in favor of the motor method of collection."

Lost Time Minimized

The Indianapolis method of ash collection is as follows: Horses, hauling trailers, pass through given alley routes, collecting ashes from house to house. The loaded trailers are then left at predetermined street locations, where empty trailers are waiting. The horses are hitched to the empties and lose no time getting out for new loads. Meanwhile the tractors, on their way to the ash dumps, couple the loaded trailers which have been abandoned at the street corners, to their trains, and continue on their respective journeys.

A trailer will hold 4 cu. yds. of ashes. Each tractor pulls a train of three trailers, making six round trips a day. The entire fleet of four trucks and 24 trailers thus hauls 288 cu. yds. of ashes daily. One cubic yard will weigh between 1,100 and 1,200 lbs.

One of the outstanding features of the motor equipment is its flexibility ,according to Mr. Ritter. The equipment is frequently diverted from ash-hauling to snow-cleaning duties. During an intensive three weeks' springtime clean-up campaign 15,000 cu. yds. of refuse were hauled. Every Saturday evening 35 trailer loads of refuse are hauled away from the city market place.

Trucks in Rescue Role

When a fire at the loading platform created an emergency in the garbage hauling department, the trucks again came to the rescue, and so impressively as to precipitate a well-defined agitation for the motorization of that department. Customarily, garbage collections are made by 35 wagons, which haul their loads to the loading platform in the central part of the city. There cranes deposit the boxes on flat cars, 20 boxes to the car. Three cars are required to haul a day's collection of garbage to the city-owned reduction plant, located about 4 miles from the loading platform.

Wagon hauls range from a few blocks up to 5 miles. One wagon will average three loads a day. During the three weeks that the trucks played the rescue role they cut practically in half the hauling expense in the garbage department. One truck proved to be the equivalent of three wagons, and it was found that a truck could be loaded in an hour and one-half. Thus a single truck accomplished in an hour and one-half the equivalent of a day's work for a horse. Moreover, the trucks traveled all the way to the reduction plant outside the city instead of only to the loading platform.

"If the garbage collection department is ever completely motorized, we can eliminate the railroad spur from the loading platform to the reduction plant, and even the loading platform itself," asserted Mr. Riley. "Each is quite a considerable item of expense." Between 90 and 100 tons of garbage are collected daily in Indianapolis.

LOAD LIMITATIONS FOR PRIMARY AND SECONDARY HIGHWAYS

By Charles J. Bennett, State Highway Commissioner, State House, Hartford, Conn.

The topic under discussion is directly connected with the consideration of the efficiency of highway transportation, a subject which heretofore has not been very seriously studied by the majority of highway engineers.

Preliminary to discussion of this topic it may be said that most of us are faced in a greater or less degree with an abnormally heavy highway traffic which has been placed upon our highways from various causes, regardless of their suitability or strength. We know that we shall be required to carry tremendous loads over the highways. We do not know the

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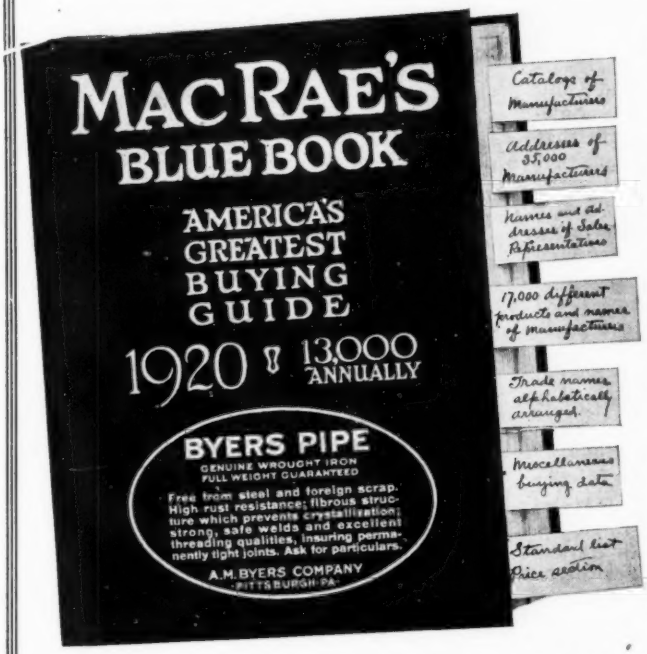
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magnitude of these loads, nor have we any assurance of a limit, either to the weight of the units or to the total volume of traffic to which our highways will be subjected.

It seems evident that before we can intelligently design highways, bridges or other structures, we must know the character, amount, weight and speed of vehicles which we are expected to accommodate. It would also seem axiomatic that it is not fair to ask for the development of highway systems everywhere to carry the extreme loads which are now being borne by motor trucks. This would mean the expenditure of vast sums of money for the accommodation of a limited number of units. Hence, we develop a need for a separation of highways into classes. For the purpose of discussion, we shall assume that highways can be divided in two classes as outlined in the subject of this article.

Primary and Secondary Highways

In order to more clearly indicate the scope of the problem, we must define the terms which we are using. In other words, we must answer the question, what are primary and what secondary highways; and, again, for purposes of discussion and not determination, let us roughly define primary highways as those highways connecting centers of industry, whether manufacturing or agricultural, over which must be carried commercial products in large quantities continuously at all seasons of the year. Secondary highways may be said to include all other highways than those classified as primary, or perhaps those roads which are required to carry traffic of a secondary importance, whether passenger cars or light commercial vehicles. These highways are those which eventually must serve all parts of the community and aid in the progress and development of the Nation.

Roughly speaking, the routes thus classified should be so correlated and so designed as to provide for the most efficient use of the motor vehicle for commercial purposes without infringing upon the field of other methods of transportation, such as rail or water. Provision must be made in design that the primary highway systems may be expanded as the need arises without undue loss in original investment. Here we have a very large field for investigation. It is not herein intended to give an absolute solution of the problem, nor to cover all of this investigation. We have suggested the need for limitation of load, and the impossibility of improving all highways to the maximum requirement has been superficially indicated.

A National Problem

The restriction of loads under these suggested limitations should be further considered. In the first place, the subject must be approached not as one concerning any particular state or group of states or any small unit of government. It must be studied as affecting the administration of all highway departments throughout the United States. In other terms, any limitations which are placed upon loads should be universal and apply to all motor vehicles, whether operated in Maine or California. This, of course, implies the passage of national or uniform state laws.

It can easily be seen from this statement that the problem is not one of easy solution. It requires broader study and stronger co-operation than we have yet been able to accomplish. It demands a knowledge of motor truck operation that is not yet available. It suggests numerous lines of thought which can be followed to conclusions which, when reached, can be collected together and used as information to impose restrictions as to weight and as data for design. The subject is not alone one of load limitation, but should be enlarged to cover any limitations which may be placed upon the operation of motors and loads, such as speed, width, height, length, number of units in a train, design of mechanism, and myriads of other things that will develop as we pursue our way.

These are, of course, generalities. We must have a starting point. We must have some specific suggestions as to the limits of the loads which may be operated on routes designated as primary and on those defined as secondary. Of course, for the purpose of securing a definite point of beginning, we must go into what has already been done along these lines.

The Limitations Set in 1918

Referring to a discussion held in 1918 in Chicago, at which both the highway officials and the motor truck manufacturers were represented, certain limitations of motor vehicles were decided. So far as the speaker is concerned, there has nothing developed since that time which would modify the conclusions there reached. These conclusions have to do with the maximum weights, widths and heights of motor vehicles, and are consequently applicable only to the primary routes, which we have defined above as those which may be considered as the

main media of highway transportation. The limits thus set were a maximum gross weight of 28,000 lbs., or 800 lbs. per inch width of solid rubber tire. The width of the load was to be 108 ins. and the maximum height, if this is correct information, 12 ft. These restrictions would allow the use of a 5-ton truck as now built, loaded to capacity, and it would seem that this is the maximum weight of truck which may be efficient for primary highways. We must realize that this limitation is not for today alone, but for the future as well, and should last for the life of the road.

Seasonal Regulation of Loads

Until, however, we have finally completed our primary highway systems, we must modify these restrictions somewhat. In other words, we must provide for the operation of these units only at such times as they will subject the road surface to the minimum wear. We must provide some method of restricting these loads to a still smaller amount at seasons of the year when the maximum damage to highway surfaces occur. This power, again, should be universal and in the hands of those intrusted with the care and upkeep of highways. Means must be provided whereby the maximum loads will be operated only on the primary systems.

Considering further the question of secondary highways, here we have still a larger subject, for we must provide a standard of construction and maintenance for all other highways than primary routes in order to carry a specified load. This portion of the problem is much more complicated and harder of solution than the former portion, for we must realize that we are dealing with the far larger amount of traffic over the secondary routes than over the primary routes. In other words, as we increase the restrictions on loads or amount of load, we are approaching closely to the maximum number of motor vehicles operated.

Restriction of Secondary Highways

For illustration, taking a certain 20,000 commercial motor vehicles licensed, only 750 of these vehicles are in excess of 4 tons capacity, while upwards of 16,000 are less than 2 tons capacity, so that our restrictions for a secondary system of highways must be such that we shall secure the maximum efficient operation of the larger number of commercial motor vehicles. For this reason it is suggested that the maximum allowable total load for secondary highways shall be 12,000 lbs., unless the load is carried on pneumatic tires, when it may be increased to 15,000 lbs. We may inquire why this increase may be made. Roughly, it is thought, and experiment tends to prove, that the pneumatic tire, properly inflated, does less damage to the highway surface than the solid tire, especially when the solid tire is partly worn. It is hoped that these assumptions may be checked up in the future and more formulae developed which will be exact rather than empirical. None of the limitations suggested have taken into consideration the passenger car, as either system, properly designed, should properly accommodate the passenger car when load alone is considered.

Enforcement of Regulations

Again, as a general conclusion to this discussion, we must admit that if any limitation of loads is determined upon, it must be enforced. There is no use or reason in attempting to establish restrictions on traffic with no intention or means of enforcement. A study of this subject would not be complete, or even partially so, without a suggestion of methods of follow-up to see that the rules laid down are carried out. The writer has knowledge of many instances where laws restricting weights are written without attempt to enforce. It is evident that such a practice is almost of no use.

In order that the universal rules suggested above may be properly carried out there will be need for co-operation between the different states in the enforcement of their licensing rules and in the checking up of the vehicles registered. Consequently, it appears that any highway system should be developed in co-operation with the motor vehicle department, and a proper policing department provided whereby it may be thoroughly established, that the laws regarding the use of the highway by loads are absolutely carried out. These departments should all be built up on a standard scheme of organization.

As outlined above, this is not an attempt to solve once and for all a problem which has been presented to us. This is impossible. There are many steps ahead of us in the proper solution of this difficulty. We have a long road to travel, but it must be traveled, and we must make a start.

This paper by Mr. Bennett was presented before the recent annual meeting of the American Association of State Highway Officials.

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EDITORIALS

RETURN TO A POPULAR SIZE

As announced in the November, 1920, issue, we return, with the present number, to the size used by this magazine for the period of 25 years, from 1890 to 1915. There have been many suggestions from the older readers, familiar alike with the earlier size now readopted and the size used during the past five years, that we return to the original size so long employed with complete satisfaction to readers, advertisers and publisher. The younger readers will soon come to prefer the smaller size because of its handiness and, we are confident, for other reasons also. Advertisers, necessarily advised of the change by letter, as well as by published announcements, have cheerfully cooperated in making the requisite changes of a mechanical nature and the publisher is deeply appreciative of this constructive spirit of co-operation which, while anticipated, is not to be taken for granted without a formal expression of sincere thanks. As was to be expected the advertisers were quick to perceive the advantage to everybody in the very greatly increased distribution of Municipal and County Engineering, effective with this issue, made feasible, in some measure, by the return to the smaller size. Contributors will note with satisfaction the opportunity to address a greatly increased number of readers and this fact suggests the great gain to the individual reader inherent in very wide distribution of the magazine.

RAILWAY AND HIGHWAY RELATIONS

In two editorials published in recent issues of this magazine we have suggested, in a polite and parliamentary manner, that the steam railway "interests," to use a collective, impersonal term, might not be inconsolable if the highway movement should bog down. We have been taken to task for this by a gentleman, long of New York and now of Ohio, who wanted to know if we are from "Ioway," associating, apparently, all unorthodox views on railway topics with the state named. Although lacking the distinction he was willing to accord us we have observed some things which have shaped our railway views according to the Iowa pattern. He suggested that it is preposterous to suppose that the railways are not friendly to the great movement for better highways, since good roads will carry business to the steam lines. This is a natural starting point for one who would invest the railways with qualities they do not possess.

We doubt if the railway nature has changed greatly in its opposition to progress. Surely many readers can remember that the yoke couplers, operated from the outside of the track, were adopted by the railways only under compulsion. Without public intervention the roads would have gone on indefinitely in the use of the old link and pin coupling and switchmen would have been getting "trimmed up," as they called it, to this day, and the railways would have continued paying damages for personal injuries and employing the maimed men for flag jobs and other light work. It was once a practice to keep engine crews on the road until the driver dropped from exhaustion to the floor of the cab, and accidents of all sorts, both major and minor, resulted from this cause. The law put an end to this visionless practice. Who does not remember the opposition the railways put up to the grade separation movement at the outset? Incidents might be multiplied at length to show that much of the progress the railways have made has been under compulsion and against the will of their managers who always have a clearer view of the dollar going out than of the dollar that may come in. Therefore, to suggest that the railways are essentially friendly to the highway movement because of a possible increase in railway business due to good roads is to reveal a very short and casual acquaintance with the railway manager's peculiar mentality. The highways will take, and are taking, some business from the railways, as everybody knows, and the railway manager is likely to be very much more impressed by this present fact than by any probable future increase in railway business in a fully developed nation with adequate highways. It is well to

remember this in considering highway and railway relations.

There is no great pleasure in making these observations but, as a journal devoted in part to the highway field, we feel that we must warn all highway workers not to expect voluntary co-operation from the steam railways in all cases. Read in this issue how poor railway service retarded highway work in Kansas in 1920, for example. Note particularly how employes of the state highway department were threatened with arrest for trespassing when they entered railway yards in search of badly needed cars which were being held in idleness.

We would not be understood as hostile to the railways, necessarily, but as somewhat familiar with their motives and methods in dealing with any public agency such as the highway. Quite likely they intend to be as generous as they feel the exigencies of the case will permit. We would credit them with the best of intentions if we were sure public opinion was sufficiently aroused to see that the intentions were practiced.

ATTEND THE 1921 ROAD SHOW

The Twelfth National Good Roads Show will be held, under the auspices of the American Road Builders' Association, in the Coliseum, Chicago, February 9, 10, 11 and 12, 1921. All those who are in any way interested in working for better highways should attend this show, as it will undoubtedly be the best, from every standpoint, ever held. The time is right and so is the place (with respect to access), and the season is exceptional in its promise of great road-making activities. Every necessary element of success is present and those who attend the show will not be disappointed.

HOME OWNING

Now that the housing shortage is so acute throughout the country, and since the housing problem is rated as an engineering problem, perhaps it is permissible for us to comment on certain aspects of home owning.

For a good many years the own-your-home movement was hampered by the attacks made on it by salesmen of blue-sky stock such as "skunk farm common" and "pecan orchard preferred." These gentlemen insisted that the purchase of a home is a bad investment because of structural depreciation, and because interest on the investment accrues against the owner instead of in his favor, etc. Now the home-owning question is just as complicated as life itself and cannot be adequately discussed in a short editorial but it may be serviceable to point out that this old bookkeeping convention, called interest on the investment, is the one thing above all others that has deterred young people from putting their savings into a home. We call it a convention for the reason that it is arbitrary. Why should a man figure interest on money invested in a home and fail to do the same on money spent for food or clothing? We shudder to think of the "cost of living" if we were required by the habit of the business community to figure the cost as of today of the food and clothing purchased in 1900, to name only one of many years, with interest on the "investment" compounded semi-annually down to this date!

All we wish to suggest is that it is easily possible to assign altogether too much weight to "interest on the investment." The average family is lucky to save some of the principal and should not be unduly concerned over the interest. If this commonplace truth can be impressed on young people there will be more home owning, more thrift, greater contentment and happiness and fewer housing shortages. The regularly recurring obligation to the young people paying for a home on a contract is the best saving device yet devised.

A home, not unlike a wife and children, is, indeed, "an impediment to great enterprises, whether of virtue or mischief," and this is well. A home is not a quick asset, fortunately for the home owner. It can't be sold in a minute, ordinarily, and the owner can think several times before he finds a buyer. This safeguards him against all manner of unwise undertakings.

There are doubtless some valid arguments against home owning, but, while accountants insist we are wrong, we could never include "interest on the investment." We have said that home owning is as complex as the fabric of life itself, being so thoroughly interwoven with it, and to us it seems that figuring the interest on money invested in a home comes close to a profane effort to put a price on the unrebuked laughter of little children.

SALVAGING OLD ASPHALTIC SURFACE MATERIAL TAKEN FROM STREET PAVEMENTS

By C. J. Van Etta, Superintendent Street Construction and Repair, City Hall, Milwaukee, Wis.

In looking over the proceedings of the convention of the American Society for Municipal Improvements, held in Buffalo in 1918, I have come upon a discussion as to the question of the use of old asphaltic mixture taken from asphalt paved streets. A municipal engineer of Buffalo, a city which has the reputation of having more asphalt streets than any other city in the country, replied to a question as to what is done with the old asphalt that is removed from cuts, etc., that it is taken to the dumps and that they have no further use for it. He says that it is used in some cases for filling holes, etc. He says it is never used for relaying. The general discussion arose as to the use of the old asphalt taken out of the streets, during which it was said the only thing that could be done with the old material, and this came from the gentleman from Buffalo, is to throw it away. He said you can't give it away and it is worth money if you can give it away. It certainly was surprising to me when I read this discussion on the use of this old material, and

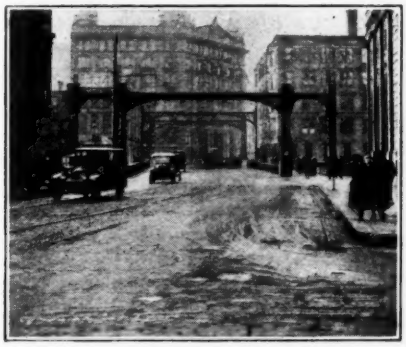
WELLS STREET, MILWAUKEE, WIS. LOOKING EAST FROM WEST WATER STREET TO ONEIDA STREET BRIDGE.

Old Asphaltic Surface With Binder Course Taken Up, Remelted and Replaced. Has been Doing Service Under Heavy Traffic Since 1912.

especially so in coming from the source it did, men who are prominent municipal engineers and road-building experts, and who, I presume, have had considerable experience in the handling of these materials.

Milwaukee Experience in Handling Old Asphaltic Surface

I am going to relate my experience as it applies to the use of this old asphaltic surface taken from streets, as to its wearing qualities and the cost of handling. For the past eight years I have been in close contact with this work, and I am satisfied that there can be no question as to the economy of the use of this old material. In the first place, our specifications are so written that they require an asphalt paving contractor, where a street is being resurfaced, to deliver the old surface material to our central asphalt repair plant. This does not cost the city a cent. This material is broken up and remelted, and there is a very small percentage of



ONEIDA STREET, MILWAUKEE, WIS. LOOKING WEST TO ONEIDA STREET BRIDGE.

Old Asphaltic Surface With Binder Course Taken Up, Remelted and Replaced. This Old Material Has Been Under Heavy Traffic Since 1912.

new bitumen added, depending entirely upon the life of the old material. I find that this old material, after being reheated, which includes the binder stone which clings to the surface, when put back into the street, gives better wearing service than did the original mixture. It appears that the reheating gives it added strength and it is a tougher mixture generally than the original.

This mixture is used entirely for patchwork, and I have in mind two different stretches of work, about two city blocks in length, which were entirely resurfaced with this old material, in a district where traffic is extremely heavy. I am showing photographs herewith of this particular stretch, to give an idea of the durability of this old mixture. This resurface work was done about eight years ago, and up to date we have spent little or nothing on its maintenance. I do not believe that a more severe test could be made than upon this particular stretch of street pavement.

Patching with Remelted Material

Our patchwork will also show that,

where a patch of this remelted material is laid, it outwears the original pavement. The cost of this work for the past eight years has averaged about 55 cts. per square yard, with approximately 400,000 sq. yds. laid during that period. I figure that the average cost of this work, if contracted, taking the eight years into consideration, would amount to about $1.75 per square yard. So it can be readily seen that we have been able to save the city of Milwaukee a great sum in this particular branch of repair work.

I was interested in 1919, while attending the convention at New Orleans of the American Society for Municipal Improvements, upon coming in contact with one of the asphalt repair gangs which was operating on one of the main streets, and inquiring of the man in charge of the work as to what he did with the old material that was taken out of the street, he informed me that it was hauled to the dump. I asked him if it could not be put to some use; he laughed at the idea and told me it was impossible to remelt the old material, as it could not be used in that state, and also that the cost of rehandling would be so great that it would be unprofitable to attempt it. I did not stop to argue the question with him, for I was satisfied that he was so thoroughly convinced, wherever he developed the notion, that he could not be shown, so I went on my way without discussing the value of using old asphaltic surface material again.

Suitable Equipment Not Available for Old Material

Up to date I have not found equipment suitable for handling this old material, although there are a number of plants which are intended solely for the use of new material for asphaltic repair work. We bought such a plant a few years ago, and to look at it today you would not believe it was the same piece of equipment we bought. It was necessary for us to rebuild this plant to take care of this old mixture. I was very much interested in the early part of the season of 1920 when a representative of the manufacturer whose plant we are using called on me, after visiting our central repair plant, and informed me that we had made changes in this plant that would be of great value to his company. This was after he had inspected the old material used, the mixture turned out and the laying of it in the street. He was very much surprised that we had been able to transform this plant from one which was intended for new material to one which is now handling old material entirely. He said that when he had called at the plant he was unable to determine whether or not this was his product. When I informed him of the percentage of new bitumen we used in this old mixture, which did not exceed 3 per cent., he would hardly believe my statement.

Other Cities Should Consider Milwaukee Experience

I find in such cities as Detroit, Buffalo, New York, Chicago, and a number of the other large cities, that they are also hauling this old material to dumps, where no use can be made of it.

I believe that any city that has any great amount of asphalt streets which have to be maintained, can do no better than follow the plan adopted by this department. In throwing this old material away cities are wasting thousands of dollars each year. I am sure that men in charge of this repair work, if they followed out our plan will, when they get well under way, readily appreciate the great saving in cost that they would be able to bring about where this particular branch of repairs is concerned.

METHODS AND COST OF EXCAVATING FOR SMALL SEWERS IN ROCK

By D. B. Davis, City Civil Engineer, City Hall, Richmond, Ind.

In constructing small sanitary sewers up to 9 ft. in depth, and where one-third to one-half the lower depth is of rock, the writer has found the following procedure is both economical and expeditious:

First, the top earth is plowed and scooped off to the side with teams to a depth of about 2½ ft. and 5½ ft. wide. The removal of this extra width has been found to pay where the earth banks will cave off into the ditch when the rock below is blasted. It also has been found more economical than trying to hold the banks with bracing, especially where the earth is only 3½ to 4½ ft. thick above the rock.

When the upper portion has been scooped out, the balance of the soil and clay above the rock is excavated with pick and shovel. The rock is then drilled, either by hand drills or steam, to a depth of at least 8 ins. below the flow-line of the pipe. This extra depth of the holes will obviate the necessity of excessive sledging to get the lower layer of rock loosened.

After the rock has been blasted the loosened material is excavated with pick and shovel. The quantity of dynamite to

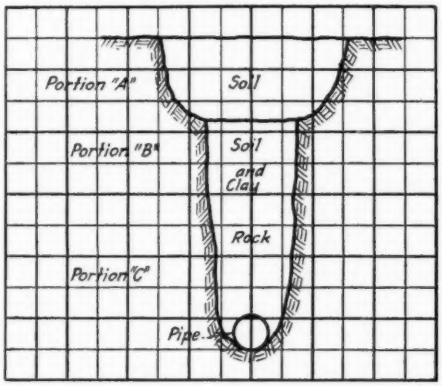
be placed in each hole depends largely upon the stratification of the rock to be blasted. In this vicinity the nature of the rock requires about 1¾ lbs. be used in a 5-ft. hole and about 1 lb. be used in a 3-ft. hole.

Fig. 1 shows a typical cross-section of a sewer trench.

Oftentimes these small sewers are dug in alleys where the space is very limted, in which case it is often a problem where to deposit all the excavated material.

The scooping of the top earth is usually done with one or two teams, with a laborer filling the scoops. It has been found that this upper portion, as represented by Portion A in Fig. 1, requires approximately 0.187 team and driver hours and 0.23 labor hours to excavate each lineal foot of trench.

The earth and clay shown by Portion B is removed with pick and shovel and requires approximately 2.14 labor hours per cubic yard of material. This portion should be thrown back from the trench as far as possible to keep it from falling into the trench when the blasting is done.

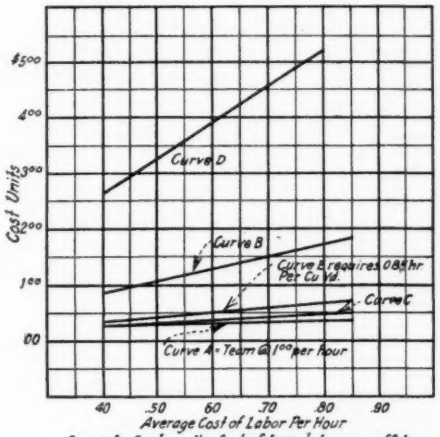


Portion "A" removed with scoops requires 0.187 team hours and 0.23 labor hours to excavate. One lineal foot of trench. Portion "B" requires 2.14 labor hours to loosen with pick and shovel out of bank per cubic yard. Drilling rock by hand requires 0.6 labor hours per lineal foot of hole. Portion "C" requires 6.5 labor hours per Cu Yd. to blast and excavate blasted material.

FIG. 1. TYPICAL CROSS-SECTION OF SEWER TRENCH FOR SMALL SEWERS WITH ROCK IN BOTTOM.

Hand drilling is usually adopted on these small sewers because the trenches are too narrow to work around and move steam drills handily. It requires the average laborer 0.60 labor hours to drill per lineal foot in depth. The holes are drilled 30 ins. apart.

The operation of blasting with electric caps and excavating the loosened material down to flow line for laying of pipe requires approximataely 6.5 labor hours per cubic yard of material removed. The pipe layer will usually carry 2 ft. of depth in the bottom and deposit it upon the pipe already laid. The labor of the pipe layer is included in the 6.5 labor hours.



Curve A = Cost per lin. foot of trench to scoop off top earth 2½ ft deep and 5½ ft wide. Requires 0.187 team hrs. and 0.23 labor hours per lin. foot.
Curve B = Cost per Cu Yd. to loosen and throw out earth above rock. Req. 2.14 hrs.
Curve C = Cost per lin. ft. to drill by hand.
Curve D = Cost per Cu Yd. to blast and throw out loosened rock to flow line. Req. 6.5 hours.
Curve E = Cost per cu yd. to back fill by hand

FIG. 2. COST OF SEWER EXCAVATION UP TO 9 FT. DEEP WITH ROCK IN LOWER PART.

The back-filling, when the trenches are dug in alleys where the space is very limited, is performed by hand and requires approximately 0.85 labor hours per cubic yard of material shoveled.

Fig. 2 shows a chart of the above costs at various rates for labor.

HOW POOR RAIL TRANSPORTATION CHECKED HIGHWAY BUILDING IN 1920

(Editor's Note.—Generally speaking, we believe the production of new highways in 1920 was disappointing to those in any way interested in road building. Poor rail transportation for highway materials was the prime cause of this disappointment. It is important to review the circumstances of 1920 to prevent, if possible, their repetition in 1921. The following very interesting statements, while pertaining primarily to Nebraska and Illinois, are considered typical for the Middle West, at least. At the recent annual convention of the American Association of State Highway Officials one of the topics for discussion was: "Difficulties Experi-

enced by the States in the Matter of Rail Transportation." Mr. M. W. Watson, State Highway Engineer of Kansas, and Mr. S. E. Bradt, Superintendent of Highways in Illinois, submitted the following data and discussions on this topic.)

In Kansas (By M. W. Watson, State Highway Engineer)

The highway program of Kansas and neighboring states suffered far more by the inefficiency of rail transportation during the past season than from all other causes combined. Of course, we had some other troubles, such as inefficiency of labor, shortage of cement and bad weather, but these troubles were Lilliputian in comparison with the rail situation. Although labor was inefficient, there seemed to be plenty of help available. What we lacked in quality we could make up by quantity or the substitution of machinery. The cement shortage seemed to be traceable back to the unsatisfactory rail situation. The hesitancy of cement companies to contract for definite deliveries was due to uncertainty. While we had more wet weather than during ordinary seasons, there were many ideal days for road building that were lost on account of the non-arrival of materials.

During 1919 and 1920 we placed under contract in Kansas 357.8 miles of Federal Aid road work; 77.1 miles of earth roadway and culverts preliminary to surfacing; 69.2 miles of gravel; 30.1 miles of macadam; 125.8 miles of concrete and 55.4 miles of brick. Of this amount we had completed on Nov. 9, 1920, a total of 90.5 miles of all types; 12.8 miles of earth, 24.2 miles of gravel, 5.3 miles of macadam, 30.9 miles of concrete and 23.3 miles of brick. Under normal conditions practically the entire mileage should have been completed at the close of the 1920 construction season.

The situation in our state is aggravated by the location of our hard stone supply so close to our coal mining territory. There is a decided lack of a well-distributed supply of stone having sufficient hardness to be used in the construction of concrete roads. Our main deposit of material of a satisfactory character is the flint spalls and chats from the zinc and lead mines of the Joplin district, being in southeastern Kansas, southwestern Missouri and northeastern Oklahoma. This deposit not only supplies a large part of Kansas, but also southwest Missouri, a considerable part of Oklahoma and a portion of Arkansas. The coal fields which supply a large part of Kansas, Missouri and Oklahoma are also located in southeastern Kansas and southwestern Missouri, only a few miles distant from the flint regions. The transportation of coal and stone by rail utilizing the same class of equipment renders it impossible to utilize returning empties (toward the coal mines) for the shipment of flint, as the road projects are located in the same direction from the coal mines as the markets for coal.

The bulk of our sand comes from the Kansas and Arkansas rivers, and in only a few instances are the plants so located as to utilize returning empties from coal shipments.

Why Call All Open-Top Cars Coal Cars?"

The producers of materials demanding open-top equipment for their shipments are now discovering that they have overlooked a valuable piece of propaganda which has been of decided service to the coal interests during the past construction season. The general public has been trained to term all cars of the open-top variety as coal cars until even the Interstate Commerce Commission seems to think that there is only one use to which such cars can be put. This fact, together with the apparently well-organized lobby of the coal interests, has been the means of securing embargoes and priority rulings until we become dizzy if we attempt to trace these orders around the circle they have been following. This Congress would render a great service to industry in general, and especially to the construction activities, if they would legislate out of use in the commercial world the three words that have spelled a large part of our grief, "embargo, priority and permit." It is true that in the end we were obliged to resort to the permit system for the highway shipments, but only to counteract the methods others interests were employing, and after all other measures had failed. Such practices during war time may be necessary, but after the close of hostilities they should be placed in the discard. They can lead only to one end—that is, preferential treatment for the industry best organized in the way of a lobby. Chairman Clark, of the Interstate Commerce Commission, recommended to the Senate Interstate Commerce Committee that a differential freight rate be granted so as to distribute the coal shipments throughout the year. Quoting his statement in part, from *Railway Age*, March 26, 1920:

Distributing Coal Shipments Throughout Year

"Such legislation would obviate very largely the pressing necessity for more

coal cars. The present supply of coal cars, while totally insufficient to handle the fall and winter rush under existing conditions, would be fairly adequate to carry all the coal desired by consumers if this equipment could be kept moving with greater regularity throughout the year, as would be the case if the advantage of lower summer and spring freight rates could be held out to induce consumers to receive coal shipments in advance of their winter needs. Under the present system thousands of coal cars lie idle during the spring and summer, while the whole available supply of coal cars is entirely insufficient to handle the fall and winter emergency.

"The acquisition of more coal cars does not afford a practicable and complete remedy for existing difficulties. Under the transportation act recently approved the Interstate Commerce Commission is given the power to require carriers to provide themselves with sufficient cars. But most of the railroads have neither the money nor the credit with which to buy a supply of coal cars adequate for current needs under the present system of large seasonal shipments, so it would be useless for the commission to order them to purchase this equipment. On the other hand, most of the railroads which have enough money or credit to finance such purchases already possess an adequate number of coal cars to care for the needs of their own patrons, and they could not reasonably be required by the commission to purchase additional cars to take care of the traffic of other lines."

Reducing the Scope of the Nation's Activities

Apparently Chairman Clark is not broad enough in his vision to realize the existence of other industries than coal. The fact of concentrated coal shipments has been the solution of our problem in the past. Coal shipments were greatest when the needs for fuel were greatest—that is, during the winter months. These cars were then available for building materials during the summer months, which is the only time when building operations can be carried on satisfactorily. The clever coal propaganda has done nothing more than secure the increase of price desired by the operators. Part of the time this season when the open-top cars were withheld from stone shipments our mines were idle. It would seem the policy of the Interstate Commerce Commission to reduce the scope of the Nation's activities to the size of our present rail transportation rather than utilize what we now have to develop our other avenues of transportation.

Holding Cars in Idleness

The other classes of equipment were also scarce, at least for our use. The grain producers of Kansas were unable to secure relief. Grain was piled high in the open in many places throughout the states while the elevators were filled to capacity. When orders were given to ship empties to the West for the relief of this situation we observed that the empty cars were allowed to stand idle in the yards for many days, while our most urgent appeals were of no avail to secure them for loading westward, even though they were to pass empty through points where the materials were needed. Refrigerator and cattle cars hold the same status as box cars in our shipping arrangement. They go eastward through the state when loaded and empty westward. Long trains of empties passed by the cement and brick plants, but were not available for use.

Through the co-operation of the State Industrial Court and our local engineers it was found that empty cars would stand in the railroad yards throughout the state for days and even weeks at a time. In some instances they were moved from one end of the yards to the other and then in a few days returned. When the railroad officials discovered that our men were checking their yards they ordered them to stay out and threatened arrest for trespassing. Why?

Conditions Changed Rapidly After Rate Raise

The most curious part of the entire procedure is the speed with which conditions changed when the higher rate went into effect and the government guarantee was removed. It seems a general theory of public utilities operation that when a higher rate is requested the service becomes almost unbearable until the public is willing to try anything for relief. Gas service becomes decidedly improved after the rate is increased, and central will give you the number requested, at least a portion of the time, after the telephone rate is advanced. Records show that the larger railroad lines operating in Kansas, and, in fact, in other states as well, are not utilizing their present equipment to its fullest capacity. One of our roads gets from 54 to 86 car miles per car day out of its freight cars, while another gets from 17 to 22, or not quite as far in a day as the average team will travel.

The investigations of our Industrial Court brought out that many unaccountable delays occurred at terminals. They

followed closely 412 open-top cars used in coal shipment from the mines to destination and return. Of these cars, 171 were loaded with company coal. The average number of days consumed in the assembling yards was 4.25. Company coal required an average of 4.29 days to travel to destination, commercial coal 3.54 days. The total car days consumed at destination in unloading and delivery to connecting lines amounted to 1,773 for company coal and 760 for commercial coal. The average travel per car day for company coal was 6.3 and for commercial coal 13.4. Of 273 cars unloaded, 4 required 30 days, 11 required 29 days, 4 required 28 days, 9 required 27 days, 10 required 26 days and 18 required from 13 to 25 days, and the surprising part of the statistics is that the railroad companies seemed to be the ones who were longest in unloading their cars. This does not look as though the grave warnings issued to shippers by the Interstate Commerce Commission were placed in properly addressed envelopes.

Some Railroads Fight Highways

Let us hope that conditions will continue to improve, but in the meantime the highway industry, which is the coming industry, should awaken to the necessity of securing adequate recognition from the powers governing the railroad situation and a better understanding with the carriers themselves. Some of our railroads have assumed the policy of fighting highway improvement and seem to look upon the highway, with its improved transportation facilities, as a serious competitor. We know that this country is developing more rapidly than all the methods of transportation, so that the highway program should be aided by the railroads rather than hindered.

If the construction of highways could be worked out so that they would build themselves by allowing the hauling of materials over the newly constructed roads as we go, we might be independent of the railroads. But it is not possible in highway work to regulate the places where we are to start as well as might be were it a private enterprise, and in most states we must depend on rail transportation for the success of our highway program.

In Illinois (By S. E. Bradt, Superintendent of Highways)

The difficulties encountered in Illinois have not differed materially from those encountered in the states of the Mississippi valley, and probably are similar to the difficulties encountered in all of the states attempting to carry on a large program of highway construction.

Shortly after the signing of the armistice in November, 1918, the states were urged by the U. S. Department of Agriculture to proceed as fast as possible with the construction of roads, with money made available from the Federal appropriation. This was urged because of the possibility of idle labor due to the slow absorption of the released army into their ordinary pursuits and because of the releasing of the thousands of people employed in the war industries.

Work Accomplished in 1919

Illinois, acting in harmony with this suggestion, proceeded to make preparations, and awarded contracts for about 570 miles of hard-surfaced roads, costing some $32,000 per mile. It was hoped that at least 400 miles would be completed during the 1919 season. This was a new era of road building in Illinois, hence many contractors were obliged to buy complete equipments, and all of them at least some additional equipment. The manufacturers, instead of being able to furnish them equipment within 30 days, as promised, required from 60 to 90 days to make deliveries. This prevented an early start on the part of the contractors. As soon as the contractors were ready for the delivery of material, a shortage of open-top cars developed. This was followed by the shopmen's strike, which crippled the motive power of the railroads; and later in the season came the coal strike, in anticipation of which all open-top cars were taken from the building industries and sent to the coal mines. The result was that instead of 400 miles being completed, we ended the season with 170 miles of finished roads and carried over to the 1920 season approximately 400 miles unfinished.

What Happened in 1920

The Bond Issue Law called for construction at the rate of approximately 1,000 miles per year. Accordingly, we made tentative plans for putting that mileage under contract for 1920 construction. Because of the handicap placed upon the 1919 construction work through the inability of the railroads to furnish sufficient equipment for the transportation of material, we visited the officials of the Railroad Administration with a view to ascertaining the possibility of obtaining cars if we undertook a program involving the addition of 1,000 miles of roads. We explained to them that the building of 1,000 miles of roads meant the delivery

of 1,000 cars of material a day. Figuring that each car would consume 8 days in making the round trip, our requirements would be at least 8,000 cars continuously during the highway construction season. We were advised that in the spring of each year, from March 1 to July 1, there was ordinarily a supply of a quarter of a million or more of idle cars, and that if we could arrange to have a large portion of our material delivered before July they would be able to take care of our requirements. In accordance with these suggestions from the officials of the Railroad Administration we arranged with our contractors for the storage of materials. They began in February and March to call for cars, but instead of the required number of cars being available it developed that the year 1920 was unlike any of the preceding years, and that there was no surplus of idle cars available. As a result, few contractors were able to get a supply of material stored in advance of construction. As soon as we asked for bids on new construction it also developed that, owing to the uncertainty of transportation, the increased price of labor and material and the uncertainty of the general situation, our bids—instead of averaging $32,000, as in 1919—averaged $44,000 per mile. With all these things facing the department, it was decided to reject bids and to award contracts for only about 50 miles instead of the amount originally planned, putting all of our effort into the completion of this 450 miles. To this end, Governor Lowden called a conference of both producers of materials and the railroad presidents, all of whom pledged the fullest possible measure of co-operation in the carrying out of the plans of the department—and it is but fair to say that in our opinion this pledge was fulfilled to the best of their ability.

Idle Construction Equipment in 1920

The contractors who were working in 1919 closed the season with approximately 100 paving machines on the ground, ready to start the 1920 construction work as soon as materials were available and weather conditions suitable. At no time during the entire season, however, were there more than 53 of the 100 machines in operation, and the average for the season was much less than 53. This situation was due almost entirely to insufficient transportation facilities.

Troublesome Orders Emanating from Washington, D. C.

The first interference with our work came in the shape of a switchmen's strike, which caused a congestion of freight cars in practically all of the centers of population in this vicinity, and prevented their movement for a number of weeks. However, the most serious difficulty experienced has been the various orders issued from Washington by the Car Service Commission and the Interstate Commerce Commission. Early in June the former commission issued an order requiring that coal mines should be given 50 per cent. of their rated car requirements, and that plants producing other commodities, requiring open-top equipment, should be restricted to the use of the remainder of the cars, whatever that might be, but not exceeding, to any one plant, more than 50 per cent. of its output. This immediately reduced the shipments of road materials. This order was followed on June 21 by another order, issued by the Interstate Commerce Commission, providing that open-top cars could be used for hauling material other than coal only when returning in the direction of the mines. This order was to be in force only 30 days, but was renewed at the end of each 30-day period and remained in force throughout the construction season. Perhaps 50 per cent. of our contractors were doing work in localities that permitted all of the material for their work to be handled in accordance with this order without interruption. The other 50 per cent., however, were getting material in localities requiring a "back-haul," which was in violation of the above ruling. Within a short time after the order went into effect the material coming to them was stopped. We appealed to the Interstate Commerce Commission and a hearing was called early in July. The result of this hearing was the issuing of special permits, but only after a delay of several weeks. These permits were granted only for the hauling of material for the completion of old contracts where work was being done on sections of important roads. Our work was all being carried on upon the main highways of the state; accordingly, by the middle of August we had secured permits for most of those contractors requiring a "back-haul" for their material. These permits were generally put into effect by the railroads, but occasionally some road would get an order from Washington to deliver a certain number of cars to some special plant for a specific coal loading, which, of course, interfered with work in that vicinity.

Much Time Spent in Getting Cars

In September an order was issued from Washington suspending all permits for a

period of 10 days. This again held up the movement of material for road work. At the expiration of the 10-day period road work was resumed, but early in October another order came from the Interstate Commerce Commission canceling all permits and requiring that additional evidence be submitted before those permits would be renewed. We succeeded in securing the renewal of not more than 5 of the old permits. Because of this interference, mainly through the two commissions above mentioned, we have been able to complete only a little more than 300 of the 450 miles. In order to do this much of the time of the officials of the department, as well as all of the time of experts hired for that purpose, has been given to the securing of car equipment and connecting it up with the producers of road materials, so as to keep contractors supplied with as large an amount of material as possible.

During the seasons of 1919 and 1920 we have built 500 miles of high-class, hard-surfaced roads. The same effort put forth under ordinary conditions and without the hindrances herein enumerated would easily have completed 1,000 miles of the same class of roads, which result would have proven reasonably satisfactory to our people.

Contractors Subject to Excessive Losses

As a result of this situation it will be seen that the people of Illinois have suffered great inconvenience because of the inability of the contractors to finish their work promptly, that the contractors have been subject to excessive losses because of insufficient transportation facilities.

It will also be seen that the producers of material, through their failure to secure cars for a normal output, will be subject to losses, due to the fact that the overhead expenses remain practically the same under a reduced output as under a normal output.

All of these losses will in a large measure come back to the people in the added cost of construction of future work. We cannot remedy the past; our problem lies in the future. We have the contractors. These contractors have the equipment. Labor has been in fairly good supply in 1920 and the indications are that it will be more plentiful in 1921. The money is available. Materials are in ample supply at their source.

Rail Transportation Principal Limiting Factor in 1921

As near as we can judge, the one principal limiting factor in 1921 will be transportation. In so far as the railroads are able to solve this problem of transportation by the purchase of added railroad equipment, by the repair of present equipment, by increasing the number of car miles per car per day, so as to carry on our work without governmental interference, just so far the improvement of the highways of Illinois and other states in the Mississippi valley will be carried on in an increasing portion. This is the important problem.

WHY ROAD BUILDING MATERIALS SHOULD BE SHIPPED AND STORED DURING WINTER AND EARLY SPRING

The road building season in the Northern States is from May to November—about six months. The average contractor, however, is able to build roads only about half of this time, for he has to contend with rainy weather, some of his men may fail to show up for work some mornings, a piece of equipment may go wrong, he may not have material, etc. There are a hundred and one things that may happen on a road job to delay it, and as a result the end of the season finds the contractor with only 75 to 100 actual working days to his credit.

The contractor is constantly trying to anticipate and prevent these delays. He adopts methods and plans his work to overcome as far as possible delays because of rains. To eliminate labor trouble he buys modern machinery that does work formerly done by hand. But his biggest delays have been because the railroads have not delivered material to him regularly during the construction season.

If the roads which are needed and wanted are to be built, something must be done to assure the contractor when he starts work in the spring that he will have his materials when they are needed. It is useless to expect him to build any considerable mileage of roads when he has to shut down his work every few days waiting for sand, stone or cement.

For that reason the Lakewood Engineering Company sent letters to contractors, highway engineers, banks, chambers of commerce, railway officials and others interested or concerned with the country's highway program, pointing out that if road materials are transported and stored during the winter and early spring months, when open-top cars are more readily available than they are during the construction season, the contractors can proceed with considerable less interrup-

tion and their working season will be increased accordingly.

What Has Been Done in Some Places

A great many replies have been received to these letters. Most of them are in hearty accord with the plan suggested and offer help in making it a success. Several letters tell what has already been done along this line. For instance, at Ogden, Utah, materials for 20 miles of road were shipped in last winter, and this road was completed during the past season in record time. The State of Delaware has followed this practice for three years.

The Board of Freeholders of Passaic county, New Jersey, have acquired a central storage yard for stock-piling road materials this winter. An Illinois city, Belleville, has already stored cement for next season's work.

It is surprising that the idea is apparently new to many. It was strongly urged last year by several State Highway Departments, as well as the U. S. Office of Public Roads. Nevertheless, many of the letters which we have received indicate that the idea is a new one in many parts of the country. The replies which have been received now make it possible to analyze the subject in detail from the viewpoint of every one interested, taking into consideration the arguments against as well as the arguments for. This analysis follows:

The Supply of Open-Top Cars and Its Relation to Road Construction

Road building materials are usually shipped in open-top or gondola cars. In the Northern States the greatest demand for these cars comes in the summer months, when they are required for handling coal, ore, sand and stone for construction work and road building, etc.

In a few instances it has been pointed out by railway executives that on their own particular lines this condition does not exist and these cars are more in demand in the fall, winter and early spring months than during the summer. However, taking the country as a whole, it is a fact that there is generally a shortage of open-top equipment in the summer and a surplus in the winter. One reason for this is because the navigation season on the Great Lakes closes in November for the transportation of coal and ore. Many cars are needed for this service during the summer and early fall.

At the close of the navigation season these care are released, and for a short time are busy carrying coal to the local territory, which can be served after the lake trade is taken care of. But this local service is practically at an end by the last of December, when there begins to accumulate a surplus of open-top equipment. The transportation of coal slumps off rapidly after this time, as coal contracts are made on April 1, and from January until that time there is only a very small amount of this business for the railroads.

It has been the general practice to request shipments of road materials during the actual construction season. The result has been that the railroads are always contending with a peak load just at the time the contractor could do his most effective work if he were able to get his materials. The inability of the railroad to furnish the necessary cars very often makes it impossible for the contractor to get well started on his work, with the result that the close of the season finds him with a job which must be carried over until next year.

On the other hand, if the surplus cars which are available during the winter and spring months could be put at work hauling materials to be stored by the contractor until his season opens, he would be assured of steady work when he did get under way.

Financing the Transportation and Storage of Materials Ahead of Time

The questions most frequently asked about the early transportation and storage of road building materials are: How is the contractor to pay for the materials and for their transportation, and why should he contract for materials at the present prices when there may be a possibility of a decline in price?

A number of states, recognizing the advantage of the early transportation and storage of materials, have made it possible to pay the contractor, in full or in part, for material when it is delivered. This can now be done in the following states:

Alabama	Michigan
Arkansas	Nebraska
California	New Hampshire
Colorado	New York
Connecticut	Rhode Island
Delaware	South Dakota
Georgia	Tennessee
Idaho	Virginia
Illinois	West Virginia
Iowa	Wisconsin
Kansas	Wyoming
Maine	District of Columbia
Maryland	Oregon
Minnesota	Vermont

In ten other states such procedure is

not possible at the present time under existing statutes. In only three states is there any sentiment against this proceeding.

In those states where it is not possible for the highway departments to make such payments it will of course be necessary for the contractor to finance the transportation and storage of materials ahead of time. In such instances he will have to arrange with his banker for the needed funds. But even if he does have to borrow the money, there is every reason why he should do so. The interest on the amount required is absolutely insignificant when compared to the sum the contractor will lose if he should have to shut down his job even only a few days because he cannot get regular delivery of material during the construction season.

There now seems no possible reason to look forward to lower prices for materials next year. Freight rates have increased and a larger demand for material is expected. The demand is increasing in many localities faster than the supply. Freight rates and the law of supply and demand are the two principal factors governing price. Therefore, it does not seem that material prices will go down. Yet even if there were hope for a decline by next season, the extra cost to the contractor buying his materials for winter and spring storage will really be only a small insurance premium guaranteeing that he will not have to close down his work every few days to wait for materials. Such slight extra cost is mighty cheap insurance.

The banks of the country are more than willing to help. A contractor needing financial assistance to aid him in shipping and storing materials early should not hesitate to go to his banker. Money loaned for this purpose is really backed by the security of the state for which the road is to be built. And what better security could be wanted?

Freezing Weather Will Not Prevent Winter and Spring Shipments of Road Material

The difficulty of unloading sand or stone which has frozen in transit is an objection which is frequently raised to the shipment of road materials during the winter months.

It is true that these materials may freeze in the cars, but material for road construction is shipped generally only a comparatively short distance, and such freezing will be confined to a thin crust unless the cars are delayed in transit or unloading. The proper unloading equipment will make it possible to get the materials out of the cars in a minimum amount of time, which will prevent it from freezing solid.

Where material is delayed and becomes frozen in severe weather, it of course will be necessary to employ steam pipes, or to apply heat in some other way to thaw it before it can be handled from the cars. But such procedure is far from impossible.

In the fall it is not possible to continue actual paving where the subgrade freezes slightly at night. Although the temperature during the day may not be below freezing, the contractor will not be permitted to place concrete. But such weather is ideal for continuing unloading and storing materials for next season's work.

In some of the Northern States, where very severe weather prevails, it would of course be necessary to withhold shipments during extremely cold weather, because even though they are transported for only a short distance, they may become frozen solid in a very short time under such conditions. However, in such states where these conditions do prevail, it is possible to ship materials at all times except during the dead of winter.

Quarries Often Do Not Supply Material During the Winter Months

Many quarries close down during the winter months; therefore, an argument has been made that materials will not be available for winter shipment.

So far as learned, the quarries close down largely because of habit. There has been no active market for them during the winter months. They have preferred to stop their work instead of assuming the burden of stocking their materials until the next season. If a market could be assured for the quarries which would absorb their output, there is no reason why they should not operate twelve months out of the year, with the exception of the time required to make repairs.

Every one who is interested in the completion of highway projects which have been planned can accomplish much good by bringing this subject to the attention of those actively concerned with the contemplated improvements. The more publicity which can be given to the entire proposition, the better. Such publicity will lead to further discussion, and such discussion will generally bring out the advisability of this practice.

FROM A VALUED READER FOR 30 YEARS

To the Editor:

You were very kind to send me the copy of "Paving and Municipal Engineering" of November, 1890 (30 years ago), with the article on the "Paving Problem" which I wrote.

A few years previous to 1890, when I finished college with the degree of C. E., I looked about to see what branch of engineering had been either neglected or not been filled with engineers. I found that the construction of pavements and roads was that field in our country. I had just returned from a trip to Europe to examine the specifications for the construction and maintenance of good roads, especially in France, Switzerland and in Germany. I therefore decided to specialize in this branch of engineering.

In 1890 the first issue of a monthly magazine called "Paving" appeared on my desk, and I at once not only subscribed for it, but wrote to Mr. Fortune, its editor and owner, that there was great need of such a publication in the U. S. and that I would gladly do what I could to help it.

The result was that he requested me to furnish a series of articles, among the first ones being the one in the issue you sent me, on the "Paving Problem of the U. S." The problem then was: First, to overcome the ignorance and apathy in our cities, counties and states in respect to roads and pavements. Second, to get rid of the construction carried on by empiricism and conservatism of politicians and contractors. Third, to apply scientific means and methods, by getting good specifications written out in full and enforcing them through the employment of engineers-in-charge.

I knew that the construction of a few good roads and pavements of properly selected materials, put together in the right way and placed in various cities and parts of the U. S., would attract the attention of the public, and that more and more would become a necessity and be in great demand. In the last 30 years the results, *so largely helped by your publication*, have been excellent and enormous. From a few miles thus constructed then there are now being constructed annually almost one billion dollars' worth, or several thousand miles of good roads and pavements.

The era of good roads and pavements in America has fully come, and the problem now is practically that of maintaining them in constant, good, viable condition, also thereby conserving the enormous capital investments in them. Economic maintenance and not cheap first cost is true economy for all public works, including roads and pavements.

It is further wise to remember that subsoil study and preparation are as important for permanent success in this branch of engineering, as the construction of pavement foundations and wearing surface layers, which, when properly done, makes it possible to maintain the surfaces in constant, good condition.

Very truly yours,

J. W. HOWARD, Consulting Engineer.
1 Broadway, N. Y., Dec. 28, 1920

OBSERVATIONS ON SOME FAILURES OF MODERN HIGHWAY BRIDGES

By A. H. Hunter, District Engineer, Illinois Division of Highways, 302 Apollo Theatre Bldg., Peoria, Ill.

To the casual observer it is apparent that the general type and character of bridge improvement work now being done by townships and counties of the State

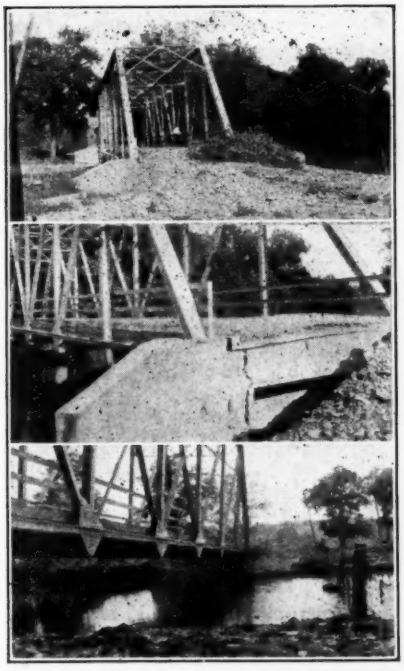


FIG. 1. FAILURE OF 125 FT. STEEL SPAN, 16 FT. ROADWAY, DUE TO UNDERSCOURED ABUTMENTS. BRIDGE DESIGNED BY BRIDGE DEPARTMENT OF ILLINOIS DIVISION OF HIGHWAYS AND CONSTRUCTION SUPERVISED BY COUNTY OFFICIALS DURING 1917. FAILURE OCCURRED IN JUNE, 1920.

of Illinois has improved steadily from year to year. Possibly this development has been more marked during the last eight or ten years than previously. I take it that the old wooden bridges and culverts have been replaced with reinforced concrete entirely, or, in the case of longer spans, with concrete abutments and steel superstructures, as fast as circumstances or funds permitted. The highway departments of the several counties have been in position to insist upon the proper design and location details. They are further to be complimented on their ability to secure reasonably first-class construction. In the face of the foregoing, however, I wish to present a word of caution, inviting their attention to the question of foundations.

For a number of years in my professional experience as District Engineer of the Division of Highways, Department of Public Works and Buildings, my superiors endeavored to impress me with the fact that more bridge failures must be attributed to poor foundations than to any other cause. Their teachings were recalled when in the early summer of 1920 I had opportunity to make inspection of some highway bridges in central and western Illinois which had failed at the time of an extreme flood. I was fortunate on this inspection in having present several county superintendents of highways, who had been present at the time of the original construction and who were more or less familiar with features encountered at that time.

Failures Due to Inadequate Support of Wings and Abutments

On traversing the territory affected, however, I was particularly impressed with the fact that practically without exception the failure of these drainage structures had occurred by reason of inadequate support for the footings of wings and abutments. It is true that many of the bridges destroyed were old and had possibly served their days of usefulness. It is regretted, however, that I have to mention that several failures were found on structures which were relatively new and had been built on approved plans prepared by experienced engineers. In order to avoid confusion, I made reasonably close inspection of the general character of materials involved. I was favorably impressed with the general character of the concrete and the workmanship that had been placed therein. Possibly there were some inherent details, such as location and distribution of reinforcing steel, which could not be determined by such casual inspection as I was able to make. In general, however, I think that the conditions as we found them positively indicate that failure of the bridges must be charged to foundations alone.

Failure of 125-Ft. Steel Span Due to Settlement of Foundation

By means of the accompanying photographs I think any one can really see the conditions that must have led to settlement. I wish to expressly invite attention to the photographs in Fig. 1, representing a large steel bridge over a small river in the western part of the State—a steel superstructure of 125-ft. span, 16-ft. roadway, supported on reinforced concrete abutments which extended some 4 or 5 ft. below the stream bed. In conversation with the county superintendent I was advised that the material encountered at the time of original construction consisted of sandy gravel, with some loose shale rock. Apparently the stream tide of high water had temporarily changed its course, with the result that scour developed along the face of the abutment and around the one wing. The result was that a settlement of 2 ft., or slightly more, had occurred in one corner, while the other wing had possibly not settled more than half that distance.

The reader will observe from the photograph that the unequal settlement caused a serious warping of the steel truss and concrete floor. A few cracks could be observed in the floor, particularly in the vicinity of the panel points. From a casual inspection, however, they did not appear to be serious, and I have reason to believe that when the bridge is jacked back to former elevation, they will not affect its strength. Later in the season extensive repairs were made at this point, and when a temporary cofferdam was constructed and the water pumped out, it was found that the scour had dug out for a depth of 5½ ft. below the bottom side of the concrete footing.

In a prairie country it sometimes seems that we are taking unjustifiable protection when we insist on placing foundations to a depth of 4 or 5 ft. below the stream line elevation. I wish now to invite attention to Fig. 2, which is that of a concrete bridge, 20-ft. span, 16-ft. roadway, built about 1910 under plans prepared by the Division of Highways. Further, inspection in the field was handled by one of our engineers, who had reasonable assurance that the structure was built according to plans, and, if we are to judge from outward appearances, it was a very creditable piece of work. It

appeared that for some reason or other, as the years went by, it developed a natural wash which had lowered the elevation of the stream line to the extent that on the day of inspection both footings were exposed. One had already settled

FIG. 2. REINFORCED CONCRETE BRIDGE, BUILT ABOUT 1910. PLANS AND PRELIMINARY ENGINEERING, INCLUDING INSPECTION, HANDLED BY ILLINOIS DIVISION OF HIGHWAYS. FAILURE OCCURRED IN JUNE, 1920.

possibly as much as 1 ft. to 18 ins. At the time of settlement the earth pressure had forced the wing and abutment towards the stream. I was advised by men present, who were familiar with the original construction, that the nature of the soil encountered at this place would normally have been considered excellent for supporting bridges, as it was a very tough blue clay. Possibly some of this failure might have been avoided if reasonable care had been exercised and the curtain walls built before the footings had become entirely exposed. In our judgment, on the day of inspection, the bridge could have been placed in serviceable condition at a reasonable expenditure.

I am of the impression that it is good practice, not only in highway work, but considered so on railways also, to provide structures that will accommodate the water for average conditions and not take into account those great floods which possibly occur once in a period of 15 or 20 years.

A Failure Due to an Extraordinary Flood

The photographs shown in Fig. 3, in my judgment, represent one of those cases where no sane engineer certainly would have endeavored to construct a bridge to accommodate the water that was forced upon it at the time of this flood. We arrived at the site a few days following the high water and had sufficient evidence from the driftwood and debris deposited to indicate clearly that when the water was at the highest point it certainly was not more than 6 ins. below the top of the girders at the higher end. I mean by this that after settlement of the one abutment had taken place, the only exposed portion of the bridge would be the tops of the girders at the opposite end. This reinforced concrete bridge was a 40-ft. span, 16-ft. roadway, built about 1916 in accordance with plans provided by the Division of Highways. The settlement that occurred possibly did not exceed 2 ft. at one corner. The opposite corner on the same abutment settled some, but possibly not more than 1 ft. One can readily imagine that with the abutment taking this position, a serious warp would occur in the superstructure. Casual inspection of the floor revealed a small number of cracks. None of these were more than hair lines, and as far as I was able to see the floor could be reported in reasonably good shape. The girder on the side where the maximum settlement occurred was seriously cracked. Strangely enough, the larger cracks were found in the vicinity of the top of the girder where the twisting action had warped the concrete. I was led to believe that should the depressed end be elevated to normal, these cracks in the top of the girder would be closed up partially. To date I have not heard that arrangements have been made for repairs. I take it that inspection after repair would be

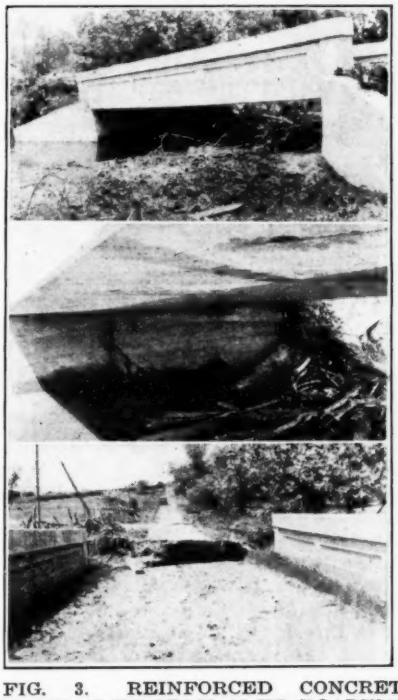


FIG. 3. REINFORCED CONCRETE BRIDGE, 40 FT. SPAN, 16 FT. ROADWAY, BUILT IN 1916 ACCORDING TO PLANS APPROVED BY THE ILLINOIS DIVISION OF HIGHWAYS, FAILURE OCCURRED IN JUNE, 1920.

well worth while and certainly instructive as to the general behavior of these cracks.

Suggested Precautionary Measures

Other photographs might be submitted as being of interest, but I think those given are typical of the conditions found. In friendly criticism of construction of this nature, I think effort should be made to impress those in responsible charge of construction of the importance of substantial supports for highway structures. In many counties I think that very few realize the importance of having experienced inspection on such work. It is appreciated that many counties are not financially able to make arrangements. I certainly would advocate, however, that those interested make effort, when excavation is completed, to assure themselves of the permanency of the foundation before permitting the contractor to proceed with construction of the substructure. In case of doubt, provide for piling, and should there still be some hesitancy on the part of the local official, consult, in the case of townships, with the County Superintendent of Highways, and should there still be some uncertainty, call upon the District Engineer of the Division of Highways in the locality.

SOME FEATURES OF THE LAKE ASPHALTUM INDUSTRY

By J. Strother Miller, Jr., Chief Chemist, The Barber Asphalt Paving Co., Land Title Bldg., Philadelphia, Pa.

Asphalt, as produced in nature's own laboratories, in so uniform a manner as to require little if any refining to make it suitable for use in paving and road building and for other purposes, has been of interest to engineers since about 1870.

In more recent years there has appeared another class of asphalt, produced in the oil industry when certain types of crude asphaltic oils are distilled. The presence on the market of asphalts from these two general sources naturally draws attention to the formation of the natural or lake asphalt considered in the present article, which also treats of a definition of asphalt that will differentiate between the two groups.

Since native lake asphalt from the famous Pitch Lake, on the Island of Trinidad, in the British West Indies, probably has had the widest application in road and street paving, the study of its origin has been conducted by engineers and geologists with careful attention.

Theory of Formation

The theory now generally accepted is that asphalt is in the process of formation today. It does not originate as asphalt, but is a secondary product, resulting from the transformation of suitable lighter forms of bitumen, malthas, or even thinner oils, into harder bitumen, by condensation and polymerization, a reaction in which sulphur and probably sulphates seem to take an important part. No high temperatures apparently are necessary, once the change is initiated, but time is required.

In the manufacture of oil asphalt, an asphaltic oil is distilled, the gasoline, naphthas, burning oils, gas oils and lubricating oils are obtained from the distillate, and the residue is controlled to give the best grade of oil asphalt obtainable from the particular crude oil under manipulation, without economically sacrificing any of the more valuable distillates.

Some Definitions of Asphalt

Almost every author of books on the subject of asphalt has advanced his own definition of the product, and as a result of this chaotic condition, several different technical and engineering societies are devoting serious attention to the subject at the present time. To show the variance, the following definitions will suffice:

First—Asphalt may be simply defined as a solid or semi-solid form of mineral bitumen, either pure or containing more or less mineral or other earthy matter. Speaking in general terms, it may be said there are three grand divisions of natural mineral bitumens, viz., gaseous, liquid and solid. The asphalts consist of a mixture of various saturated and unsaturated solid hydrocarbons and their derivatives.

Second—(1) Asphalt, solid or semi-solid native bitumens, consisting of a mixture of hydrocarbons, of complex structure, largely cyclic and bridge compounds, together with a small proportion of their sulphur and nitrogen derivatives, but free from any appreciable amount of solid paraffines, melting upon the application of heat and evidently produced by nature from petroleum containing little or no solid paraffine. Solid or semi-solid residues produced from probably similar oils by artificial processes are sometimes called asphalts, but should properly be termed oil asphalts. The more common types of native asphalts are known by the name of the locality in which they occur, such as Trinidad, Bermudez, Maracaibo, Cuban, California, etc. Native asphalts with few exceptions contain water, ex-

(1) Office of Public Roads, Dept of Agri., Circular No. 93.

traneous organic or vegetable matter and inorganic matter, such as clay, sand, etc.

Third—(2) Solid or semi-solid native bitumens. Solid or semi-solid bitumens obtained by refining petroleums, or solid or semi-solid bitumens which are combinations of the bitumens mentioned with petroleum or derivatives thereof, which melt on the application of heat, and which consist of a mixture of hydrocarbons and their derivatives of complex structure, largely cyclic and bridge compounds.

NATIVES MINING ASPHALT IN TRINIDAD LAKE.

The Two Great Asphalt Lakes

The largest amount of native lake asphalt has been produced from Trinidad and Bermudez asphalt lakes. Roads and streets paved with these materials are found in virtually every state in this Nation, as well as in many countries in foreign lands, and these materials have withstood traffic in many cases for 30 years or longer.

The two great asphalt lakes are situated in South America, the Trinidad lake on the western coast of the Island of Trinidad, and the Bermudez lake on the eastern coast of Venezuela, about 30 miles inland by air route. The Gulf of Paria, about 85 miles in width, lies between Trinidad and the mainland of South America.

Trinidad is about 2,000 miles south of New York City and about 700 miles north of the equator. Its area is about 1,700 square miles, or a little less than that of the State of Delaware. The climate is tropical, but the island is favored by the trade winds, which tend to ameliorate the intensity of the heat. The temperature averages about 85 degs. F. the year round and never varies more than 20 degs.

The term "lake," when applied to a deposit of asphalt, may seem a misnomer, but "lake" best describes the places where nature has concentrated the output of bitumen.

The Trinidad Lake

Trinidad asphalt lake is situated about one mile from the sea, 138 ft. above sea level, and is about 114 acres in extent. Its surface is undulating, the mass of asphalt seemingly lying in great folds. Where these folds meet great crevices occur, their depth varying from a few inches to a few feet. Miniature canals, formed by the collection of rainwater in the crevices, run in all directions over the surface of the lake.

The mass of asphalt is in imperceptible, constant motion, which can, however, be detected only by noting the relative position of the miniature canals at various times or by observing the deflection from the vertical of drills used in borings to find the depth of the deposit.

Depth of Lake

The greatest depth of the lake never has been found. Recently a drill was forced more than 150 ft. below the surface, the entire boring being through solid asphalt of uniform character and composition, but the drilling had to be abandoned, as the tube or casing had been carried so far from the vertical (1 ft. in 6) as to render any further efforts valueless.

The depth found, however, indicates an almost inexhaustible supply of uniform material. While mining of asphalt at Trinidad has been carried on continuously for more than 38 years, the level of the lake has dropped only 6 or 8 ft.

BERMUDEZ ASPHALT LAKE, SHOWING SURFACE WATER IN FOREGROUND.

The new material is either of the same character or replenishment is so very deep that the borings do not indicate a change in character. The borings near the edge of the lake show considerable slope to the sides, and it is believed the lake rests in a bowl-like depression, probably an extinct mud volcano.

Taking Asphalt from the Lake

A narrow-gage railroad runs from the refinery and an endless cableway out over the lake, turning in a large semi-circle so as to traverse as much of the lake as pos-

(2) Standard definitions of terms relating to materials for roads and pavements, Serial Designation D-8-18, American Society for Testing Materials.

sible. Although this road is not ballasted, there is very little sinking of the ties into the asphalt. A train consisting of several small flat cars, each equipped with a dumping bucket of about 500 lbs. capacity, is pulled over the track by an endless cable running over the ties, and by means of a portable clutch a native on the front of the train controls the stopping and starting.

Natives equipped with broad mattocks dig great lumps of the asphalt from the lake, loading them into the cars by hand.

LOADING SKIPS ON THE NARROW GUAGE RAILROAD WHICH TRAVERSES TRINIDAD ASPHALT LAKE.

The depression left by a day's mining operations is filled within 48 hours, another proof of the continual motion of the mass of asphalt.

The loaded cars are pulled either to the refinery or to the terminus of an endless overhead cableway, which carries the buckets down hill and out over the dock to the steamer. From a high pier the buckets are dumped directly into the hold of the waiting vessel.

In the holds of the steamers which carry the crude asphalt to all parts of the world, the material amalgamates into a solid mass, and it is necessary to dig it out in lumps at the end of the voyage.

The Bermudez Lake

The location of the Bermudez asphalt lake, in Venezuela, is in striking contrast with that of Trinidad's deposit.

The only means of approach to Bermudez Lake from the Gulf of Paria is by steamers, up an uninhabited river called the San Juan. During the five-hour trip the only scenery consists of mangrove swamps on each side of the wide and placid stream, and the only signs of life are multitudes of myriad-colored birds.

The last five miles of the trip is up a tributary of the San Juan, the Guanoco river. In reality, the Guanoco is little more than a deep creek, and is so narrow that steamers are forced to turn at its mouth and back up stream, that they may have a straightaway course when loaded.

From Guanoco, the loading point for steamers, a narrow-gage railroad leads through 7 miles of dense tropical jungle to the asphalt lake. It is impossible to step from the bed of the railroad without going ankle or knee deep into water. Tropical flowers of wondrous beauty and birds with plumage of many colors abound in the forests and swamp lands.

Bermudez Lake covers an area of about 2,000 acres, and in those parts which have been worked the depth of the asphalt varies from 3 to 10 ft. The asphalt is softer than that of Trinidad, and it is necessary to move the ties of the railroad which traverses the lake at frequent intervals, to prevent them from being submerged in the asphalt. There is considerably more water on the surface of the lake, rendering the operation of mining more difficult. There is also a large amount of muddy silt, washed in from the hills to the west, which must be mucked off the top before asphalt is reached.

Consequently the vegetation on Bermudez Lake far surpasses that on Trinidad

DUMPING ASPHALT FROM SKIP BUCKETS DIRECTLY INTO HOLD OF STEAMER AT BRIGHTON, TRINIDAD.

Lake, where a few "islands" of stunted trees and straggly bushes dot the surface at infrequent intervals.

Taking Asphalt from Bermudez Lake

The asphalt is loaded by hand into dump cars, which are pushed by natives to an elevated track at the edge of the lake, where they are dumped into wooden

skips. The skips are hauled on flat cars 7 miles to the steamer's side, at Guanoco, where the asphalt is dumped into the hold. The crude material runs together the same as does the Trinidad.

The refining of both Trinidad and Bermudez asphalts is the same, so the description of the process through which the former material is put will suffice.

Refining Trinidad Asphalt

As obtained, crude Trinidad asphalt contains approximately, and uniformly through all cargoes, 39 per cent. of bitumen, 32 per cent. of mineral and other matter, and 29 per cent. of water. For comparison, Bermudez crude varies as to its water content, averaging about 25 per cent., 1 to 3 per cent. of mineral matter, and 68 to 72 per cent. of bitumen.

Refining consists of driving off the water in a steam-heated still, open at the top, at a temperature of about 350 degs. F. The asphalt then is either drawn off into slack barrels, surface cooled by water to prevent splashing while being hauled about the refinery yard, and shipped direct to customers, or it is fluxed before being drawn from the still.

Fluxing of a refined asphalt consists in adding a predetermined quantity of a petroleum residuum, or flux, which is bought under stringent specifications, assuring a uniform material suitable for paving and other purposes.

Refined asphalts have a consistency or penetration of from about 2 degs. for Trinidad to 20 degs. for Bermudez, and are too hard for use in paving operations. The proper consistency is dependent upon climatic and traffic conditions, as well as the grading of the mineral aggregate with which it is mixed to produce a paving mixture.

The fluxed asphalt must not be too hard in cold weather, and yet not too soft in summer.

Every one probably has noticed, and heard unfavorable comments upon, the softness of some sheet asphalt pavements in summer months. But few can recall seeing a sheet asphalt street with heel marks, horse calk marks or tire tracks in it in winter. The marks iron out, and a pavement that does not mark a reasonable amount in summer must be viewed with suspicion, for it probably will be too hard during the colder periods. This is one instance where technical control has been and will continue to be of material assistance to the paving industry.

When the refined asphalt is fluxed, it is called an asphalt cement, since it is used to cement particles of mineral matter together. The fluxed material is shipped in barrels, and is ready to use when received, with the exception that it has to be remelted.

Asphalts have been applied to many different uses in the past few years, and the simple fluxing to varying degrees of consistency is not the only operation today. Asphalt for some uses must be the softest that can be produced, while for some other uses asphalt with the same melting point, but a much harder consistency, is required. Such variations are obtained by proper blending of two or more asphalts or the incorporation of materials other than asphalts.

Obviously the type of material suitable for use in hard rubber compounds would not be suitable for saturating canvas to produce a water-proof and mildew-proof piece of goods. The asphalt for either of these products would not be applicable for building tank linings to withstand temperatures up to 120 degs. F. and mixed acids, such as sulphuric and nitric of about 25 per cent. strength, such as are met in the dye industry.

Colloidal Matter in Trinidad Asphalt

The presence in Trinidad Lake asphalt of mineral matter in a colloidal state differentiates this bitumen from either the asphalt from Bermudez Lake or the artificial or oil asphalts. Scientific investigations have convinced us that the colloidal clay has a direct bearing upon the service which Trinidad streets have rendered, and are rendering today.

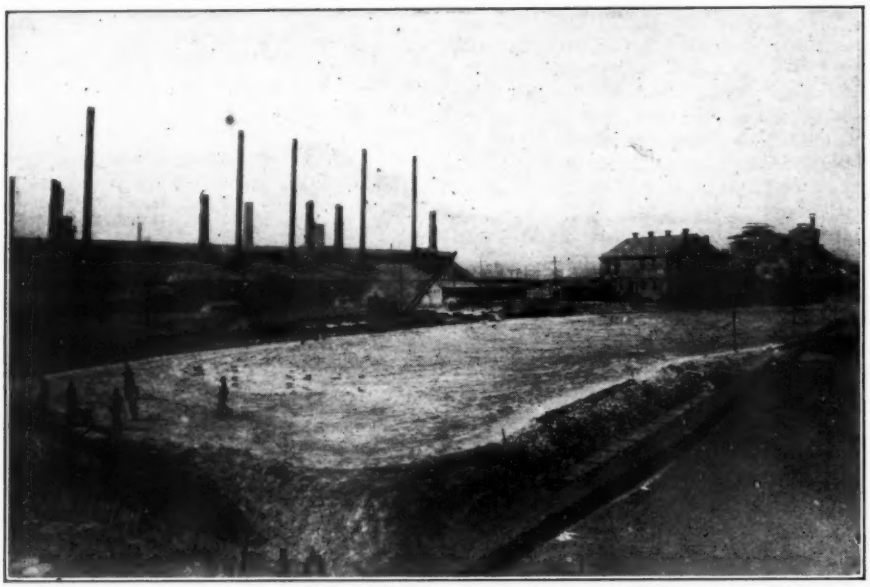
For many years the insistent presence of a small percentage of mineral matter in all bitumen extracted from Trinidad Lake asphalt baffled the operators. While all felt it was a very finely divided clay, it was not until 1914 that Clifford Richardson initiated the work that finally showed these particles in the ultra-microscope.

How this clay occurred in this manner is explained by Mr. Richardson briefly as follows :

"The crude asphalt in the lake consists of a complex system of several phases, gaseous, liquid and solid, organic and inorganic, more or less in equilibrium, displaying colloidal properties of industrial as well as scientific interest. The asphalt owes its origin to certain geological conditions existing side by side in that locality. Oil sands occur at different depths, which contain vast quantities of petroleum, as has been demonstrated by the many wells which have been successfully sunk, a petroleum of unique character, differing from any previously known, and

of a highly asphaltic nature. Rising toward the surface along some line of least resistance, the petroleum meets the paste of fine silica and clay which form the mud of the spring. With this the oil becomes emulsified, probably by the action of the natural gas which accompanies it at very high pressure. In the lapse of time the entire crater of the spring has been filled with the resulting material and it has overflowed the rim, running down the slopes of the sea. Fresh material is in process of formation today and issues at several points on the surface of the deposit, of a consistency so soft that it can be readily moulded into balls with the hands, without adhering to them, owing to the free water with which it is associated. This so-called 'soft pitch' is also accompanied with natural gas of unusual composition, containing in addition to the hydrocarbons usually found in such gas, carbon dioxide and hydrogen sulphide, in some localities in the neighborhood of the deposit, as much as 33 per cent. of the former and 3.5 per cent. of the latter. At the same time the soft pitch itself is evolving gas, either the result of the release of pressure or of a reaction going on between the bitumen and the mineral matter it contains, this gas consisting largely of hydrogen sulphide and carbon dioxide, probably the latter cause, as it continues for years after the material has been exposed to the air, while if the soft asphalt is sealed up in a tin can the latter will explode in the course of time from the gas pressure developed.

"The main mass or older form of the asphalt in the crater is sufficiently hard to make it possible to flake it out in large pieces of from 50 to 100 lbs. in weight. In this form it resembles an exaggerated Swiss cheese, owing to the gas cavities it contains. While brittle enough for this, an excavation of some depth at any point is filled up and obliterated in 24 hours by the flow of asphalt from the adjoining material. Large masses of the asphalt taken from the deposit and kept in storage, without lateral support, present all the features of the glacial flow of ice.



MINIATURE ASPHALT LAKE AT THE REFINERY AT MAURER, N. J., INTO THIS BASIN CRUDE ASPHALT IS DUMPED WHEN UNLOADED FROM STEAMERS, AND LEFT UNTIL NEEDED. THEN IT IS DUG OUT AND REFINED.

"The asphalt, therefore, originating in a soft condition, as demonstrated by the fresh material, which is constantly being formed and which emerges near the center of the deposit, becomes hard in the course of a year or two. The cause of this and of the evolution of the gas which is observed may be attributed to the presence of a catalyzer. The asphalt contains clay in highly dispersed condition, carrying adsorbed ferrous sulphate, which may play such a role."

In the endeavor to reproduce these conditions clays from many different sources, including clays from oil springs found on the Island of Trinidad, have been experimented with in many ways, and that

method showing the most promise is to make a clay slurry with water, adding this to a pure bitumen at a temperature below that of boiling water and slowly cooking out the water. This method results in some colloidal particles in the bitumen, but not nearly approaching the number per unit of volume as found in the lake asphalt.

These minute particles of clay no doubt adsorb the bitumen, creating a surface energy far in excess of any type of mineral filler added to a bitumen in the usual dry way, such as in making a sheet asphalt mixture.

First Modern Asphalt Pavement

Asphalt from Trinidad Lake was used in the first modern asphalt pavement by the originator of this now standard form of paving, in 1870. The inventor, E. J. DeSmedt, in an effort to get away from the use of coal-tar as a cementing material, laid a pavement with a mixture of sand, powdered limestone and Trinidad asphalt, softened with the residues from the distillation of petroleum. His idea was to imitate the rock asphalt pavements of Europe, since the material used abroad was not readily available or economical at that time in this country.

The asphalt paving industry properly started with the laying of the first piece of pavement of any size in front of the City Hall in Newark, N. J., in 1870. In 1871 or 1872 another piece was laid in Battery Park, New York, and in 1873 a section of Fifth avenue, opposite the Worth Monument, was put down. The latter section, with one or two resurfacings, remained in place until 1887. Eighteenth street, between Fourth avenue and Irving Place, was paved with a Trinidad mixture in 1874 or 1875, as were Twenty-eighth street, between Broadway and Fifth avenue, and Thirty-eighth street, from Fifth avenue to Madison avenue.

These small pieces of work originated the modern asphalt paving industry in America. They were sufficiently successful to attract attention, and when Congress, in 1875-76, provided for paving Pennsylvania avenue in Washington, from the Capitol to the Treasury, the commission appointed to select the type of pavement decided upon asphalt. The work with the Trinidad mixture proved successful, and from that date on native lake asphalts were used in increasing quantities in almost every large city in the United States.

Bermudez Lake asphalt has been used extensively for asphaltic concrete and asphalt macadam highways, when the increasing use of motors called for roads capable of carrying an enormous volume of traffic.

UNIQUE SEWER CONSTRUCTION IN KANSAS CITY, MO.

By Paul A. Hartung, Mem. Am. Soc. C. E., Engineer of Sewers, City Hall, Kansas City, Mo.

The construction of a sewer with very difficult and unusual features has recently been completed in Kansas City, in which the contractor proved himself to be both prolific of ideas and ingenious in their execution.

An Old Sewer

About 40 years ago a 5-ft. 6-in. 2-ring brick sewer was constructed in Walnut street, extending from Twelfth street to Seventeenth street, and as this portion of Kansas City was undeveloped the sewer angled across the block to Eighteenth and Main streets, thence south in Main street to Nineteenth street, west in Nineteenth to the alley immediately west of Main street, thence south in the alley to an outlet into O. K. Creek.

As this part of the city developed it became necessary to abandon that part of the sewer extending from Seventeenth and Walnut streets to Eighteenth and Main streets, for the reason that the sewer was so shallow that it interfered with basement installation and basement drainage and was of no further value.

From Eighteenth and Main to its present terminus (into a concrete sewer constructed by the Kansas City Terminal Railroad Company), the depth of the sewer rendered it useless for basement connections, and due to the fact that the property contiguous to the sewer is rapidly developing, and in all cases basements are being installed, it became necessary to conform to the demands of the property owners to relieve the situation. This department therefore proceeded to prepare plans, and after passing through the customary legal matters, the contract was awarded the Wm. D. Boyle Construction Company, under the date of Aug. 24, 1920.

Description of New Sewer

Beginning in an existing 18-in. sewer in Main, at Eighteenth street, the plans show the new work starting out with a 21-in. vitrified clay pipe across Eighteenth to the south side of Eighteenth and west side of Main, west to alley west of Main; at this point the depth of sewer is 25 ft.; south in alley to Nineteenth, where old sewer is diverted into it, continuing in

alley in 33-in. monolithic concrete paralleling old sewer, and being 8 ft. below the bottom of same at Twentieth street, where a 24-in. brick and an 18-in. vitrified clay pipe sewer are taken in; continuing in 36-in. monolithic concrete to a point 680 ft. south of Twentieth street, where it intersects the old sewer. The old sewer was in fair condition, but was repaired by placing a concrete invert up to the spring line. The alley is paved, and, as a trafficway, serves many industries which continually use it, and a wave of protest arose when the contractor began construction by the old method of open trench work, which would have entirely blocked the alley and made it impossible for these industries to function.

Sewer Constructed in Tunnel

The contractor was therefore ordered to dispense with this method and to tunnel for intervals of 250 ft. between shafts. This method was carried out successfully throughout the work, a distance of 1,700 ft.

Owing to the depth of the sewer and its closeness to the buildings which line the alley and the old sewer, this appeared to be a hazardous undertaking, but not a single accident occurred during the entire work.

The tunnel was excavated 4 ft. wide by 4 ft. 6 ins. high, and as the material was loosened it was loaded into wheelbarrows and taken out at the shaft and temporarily disposed of in vacant lots adjacent to the work. As the tunnel was driven foot by foot, the material was held in place by placing 2x12-in. timbers entirely around the heading, thereby forming a solid box. This method proved to be so successful that in not one instance was a cave-in recorded.

Concrete Poured to Tunnel Through Auger Holes

Concrete was mixed and poured from the surface of the alley by boring holes with an ordinary 12-in. auger down to the sewer. The invert to the spring line was poured first, then forms were inserted and the top was poured. One man kept constantly in the tunnel to ram the concrete as it flowed in. (The writer personally inspected a large percentage of the completed sewer and found very few honeycombs.) The necessary slants were placed and recorded, and the existing connections to the old sewer changed to the new. The 21-in. vitrified clay pipe was placed by lowering it at shafts and conveying to the point of usage.

The Contractor's Skill

The contractor commenced work Sept. 1, 1920, and finished Dec. 15, 1920, although the contract date of completion was April 1, 1921, an approximate saving of one-half the time. Much credit is due the contractor for the very efficient manner in which the work was handled, being without delay to traffic, an accident to life, injury to adjacent buildings and without interruption to the sanitary flow in old sewer, which he was required to maintain during construction.

The total cost of this work is in the sum of $44,000, which will be paid in four annual tax bill assessments against property in this district, at the rate of $0.0346 per sq. ft.

LONG SECTION OF NEW CHICAGO-ST. LOUIS HIGHWAY DEDICATED AND OPENED

A 117-mile link of the new Chicago-St. Louis highway, from Sparland to Chatham (Ill.) was recently formally dedicated and opened to the use of the public, and the opening of the road was attended with some noteworthy features. This is the longest stretch of paved road yet completed under the Federal Aid Act.

The entire road is paved with concrete and along this magnificent rural boulevard lie the cities of Springfield and Peoria, as well as a score or more of smaller towns and villages and hundreds of farms in what is one of the richest farming districts in the world. Special significance is attached to the completion of this road, since it is the first large project to be completed of the 4,800 miles of hard-surfaced roads that are to form a connected and state-wide system of highways in Illinois.

Much enthusiasm was exhibited over the road by those served by it, and large delegations of state, city and county officials came from various cities along the route, meeting at Mason City for the dedication and celebration exercises. In spite of rain and generally unfavorable weather, several hundred cars started out on the road, arriving on schedule, without discomfort or inconvenience, while the muddy and slippery feeder roads gave a constant reminder of traveling conditions on unimproved highways. As the procession proceeded farmers were waiting at their front gates and at every cross-road to fall in line and help celebrate.

Governor Lowden Principal Speaker

Governor Frank O. Lowden was the principal speaker at the dedication. He complimented the public for its vision in

building the road and the engineers for the manner in which they had carried on the work in spite of the handicaps of strikes, railway transportation difficulties and other embarrassments. He drew attention to the fact that Illinois was a close second to Pennsylvania, that State having built the most mileage of paved highways during 1920, and approved in general the road work that is proposed and the completed work as exemplified in the concrete pavement just finished. Clifford Older, Chief Highway Engineer, told of the immense amount of work required to build highways, and pleaded for the proper care of finished roads, saying that they would last if not subjected to loads for which they were never designed. He asked that caution be practiced in driving, to prevent accidents and injuries. S. E. Bradt, Superintendent of the Division of Highways, and Frank I. Bennett, Director of Public Works and Buildings, also addressed the gathering as representatives of the State engineering and road-building officials. Mr. Bennett said 800 miles of improved road would be completed by the end of next year.

The Father of Good Roads in Illinois

Perhaps the most applauded speaker of the day was Hon. Homer J. Tice, of Greenview, who is known throughout the State as the father of good roads and who is responsible for much of the constructive legislation on the statute books that allows roads to be built in their present state of efficiency. "For 27 years I have been preaching the gospel of good roads," said Mr. Tice, "and today I feel that actual good has been accomplished. People are generally recognizing that the greatest force for citizenship and Christianity is hard-surfaced highways." Officials of various cities addressed the crowd, invariably remarking on the benefits that the new road is bringing.

Effect on Other Communities

One of the most interesting events of the day was the arrival of boosters from Havanna, the county seat of Mason county. The concrete road does not pass through that city, and a special train was hired by that city and headed by its band to parade the streets, bearing signs on which were the legends, "We are walking because we have no paved roads," "Our Road is Paved with Straw," and other propaganda designed to enlist interest in connecting Havanna with the concrete road between Peoria and Springfield. Ed. Hull, one of the leading road enthusiasts of Peoria, called attention to the fact that Havanna had helped get the main road through and that it was now the duty of the places that already have roads to help outlying districts to connect up with the main system.

Road Location Features

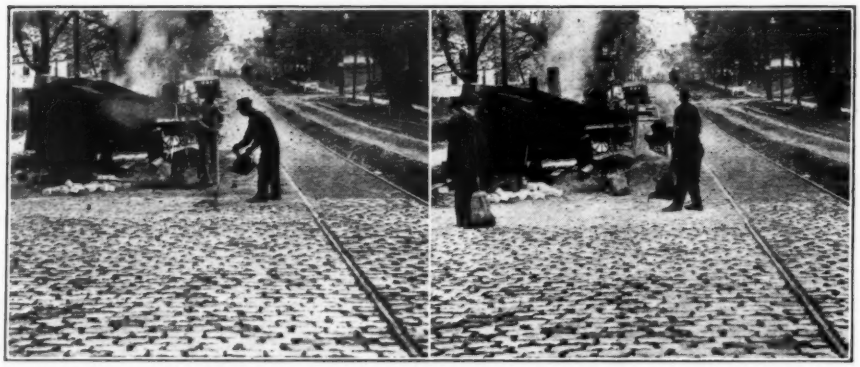
Much comment was elicited from the automobilists traveling the newly finished road, particularly the safety features incorporated by the engineers in charge. For the most part, the road follows section lines, but there are frequent jogs and many turns. Where these turns are less than an eighth of a mile new locations have been made and easy reverse curves put in their place. All right angles have been reduced to curves having a radius of not less than 205 ft., and the curves are super-elevated or "banked" 1 in. to the foot, making them safe for traffic at good speed. All curves have good visibility, so that approaching cars may avoid meeting head-on at turns.

Willis Evans, Executive Secretary of the Peoria Association of Commerce, believes that the concrete road running through that city will help take care of the house shortage, but will change the shape of the city. He thinks the future trend of the city population will be along the road, tending to elongate the city limits and relieving the congestion that comes with a concentration of populatiou. Wm. E. Stone, President of the First National Bank of Peoria, said that the new road was the greatest improvement that could have been made to either the city or the surrounding country, and he hoped the full program of paving would be carried on as speedily as possible.

MODERN GRANITE BLOCK, ASPHALT-FILLED, PAVEMENT CONSTRUCTION IN CINCINNATI

Frank Krug, Chief Engineer of the city of Cincinnati, Ohio, has the reputation of getting more value per dollar of expenditure for his street improvement funds than is usually obtained, and his method of procedure, while interesting, is by no means a mystery.

In the first place, Mr. Krug is a great believer in fitting the type of improvement to the local conditions. When a paving improvement is proposed he makes a detailed study of the street, taking into consideration property values, district to be served, present and probable future traffic, grades, drainage—in fact, endeavors to consider the proposed construction from all angles. With this information



VIEWS OF ASPHALT-FILLED GRANITE BLOCK PAVEMENT CONSTRUCTION IN CINCINNATI, OHIO.

Left: Applying Texaco Asphalt Filler After First Sweeping Pebbles into the Joints. Right: Second Sweeping of Pebbles into Joints Immediately After First Application of the Asphalt Filler.

at hand, he decides upon the type of pavement which will best suit all conditions for the particular street improvement.

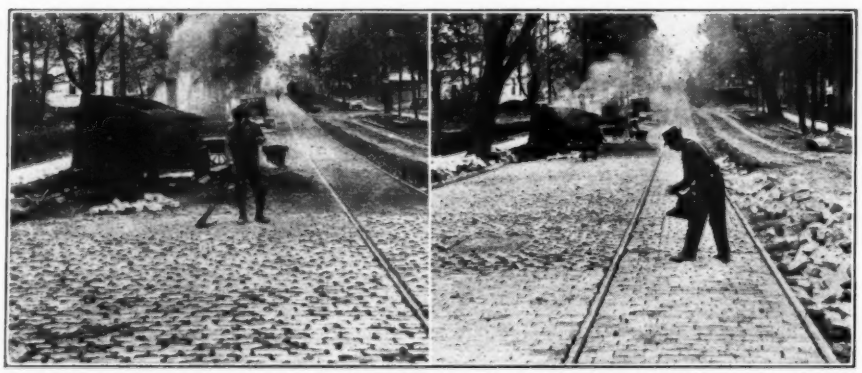
The following is a specific instance of how Cincinnati, through its Engineering Department, receives its dollar value:

The Cincinnati-Hamilton pike within the city limits is known as Hamilton avenue and receives the bulk of the traffic entering the city from the north. Naturally this traffic includes all types, from fast-moving, heavily laden trucks to pleasure automobiles and one-horse vehicles. Taking into consideration the heavy traffic this street receives and the fact that it undoubtedly will increase rapidly in the future, together with the various grades, it was decided after thorough investigation that the most satisfactory and economical pavement, considering all conditions, would be granite block.

The following provisions are included in the detailed construction specifications for Hamilton avenue:

A foundation of 7 ins. Portland cement concrete, mixed in the proportions of 1:3:6, was laid on a thoroughly compacted and well-drained sub-grade. Upon this a paving bed of 1¼ ins. in thickness, of clean coarse sand free from pebbles over ⅜ in. in diameter, was placed. The blocks used in the pavement were Georgia granite from the Lithonia district, near Atlanta, Ga. The sizes were from 3¾ to 4¼ ins. in width, 3¾ to 4¾ ins. in depth, and from 8 to 10 ins. in length, averaging about 32 blocks to the square yard. The joints of the pavement were filled with asphalt filler and clean, dry pebbles passing a ½-in. screen and retained on a 3/16-in. screen, as follows:

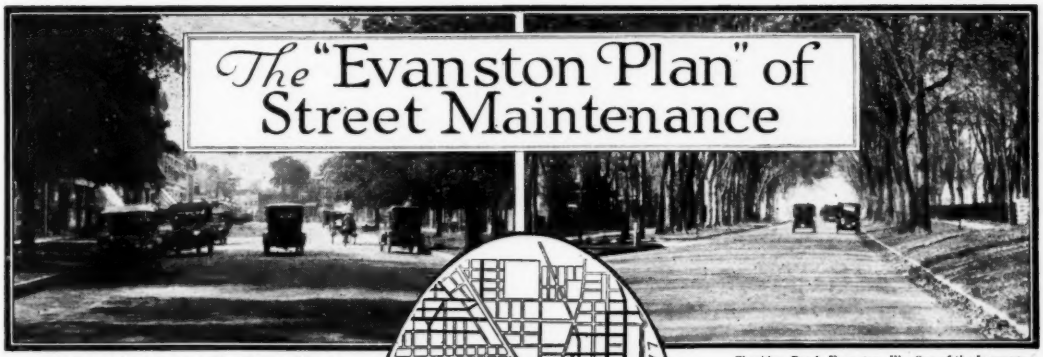
The pebbles were hand-swept into the joints in three operations, each application being followed with a hand applica-



VIEWS OF ASPHALT-FILLED GRANITE BLOCK PAVEMENT CONSTRUCTION IN CINCINNATI, OHIO.

Left: Second pouring of Texaco Asphalt Filler Following the Second Sweeping of Pebbles into the Joints. Right: Making Third Application of the Asphalt Filler Completely Filling the Joints and Leaving a Flush Coat on the Block and Covering This With ¼-in. Layer of Dry Pebbles.

The "Evanston Plan" of Street Maintenance



Orrington Ave., Evanston, Ill., Old waterbound macadam surfaced with "Tarvia-A" June, 1919.

Sheridan Road, Evanston, Ill. One of the Improvement Association Streets, constructed with "Tarvia-A" in 1915-1919.

WITH natural pride in their beautiful city, which lies just north of Chicago, the property owners and city authorities of Evanston, Ill., have worked out what has come to be known as the "Evanston Plan" for keeping their macadam streets in first-class condition.

The property owners on many streets have local Improvement Associations, who voluntarily contribute to the cost of maintenance of their street. This fund was formerly used for street sprinkling, but is now being used in systematic Tarvia maintenance. The work is handled by the street department under the direction of the Commissioner of Streets. This has worked out so satisfactorily that some of the Associations have a surplus in their treasury, where formerly all the funds went into street sprinkling, and the streets are dustproof, waterproof and automobile proof.

Keeping Ahead of Old General Neglect

The policy of the City of Evanston is to repair and re-treat the streets *before it is absolutely necessary.* Three patrol gangs are kept on the streets all summer immediately patching any spot in the macadam that begins to show signs of wear. As a result, the entire system of more than a half million square yards of Tarvia-treated macadam pavement is kept in wonderful condition all the year round.

In fact, the streets of Evanston form a striking testimonial to the efficiency of systematic Tarvia treatment and low cost maintenance.

The Efficiency of Barrett Service

The present Commissioner of Streets, Mr. R. M. Brown, writes as follows:

"Efficiency of service by your company in the delivery and application of Tarvia to the City of Evanston during the past season has been very satisfactory.

I assure you that your efforts in our behalf are appreciated, as we are able to keep our pavements in good serviceable condition despite the fact that they are subjected to unusually heavy traffic."

Property Owners Prefer Tarvia

Former Commissioner of Streets Mr. Walter W. Krafts, before leaving office, wrote as follows:

"The people of Evanston are satisfied in every respect, and in asking for work to be done on streets, are asking for Tarvia in preference to other binders."

The Evanston plan of street maintenance is attracting a great deal of attention in other municipalities.

We should be very glad to explain this plan in greater detail to any interested city official or property owner upon request. In writing, address the nearest Barrett Company office.

Tarvia

Preserves Roads—Prevents Dust

Special Service Department

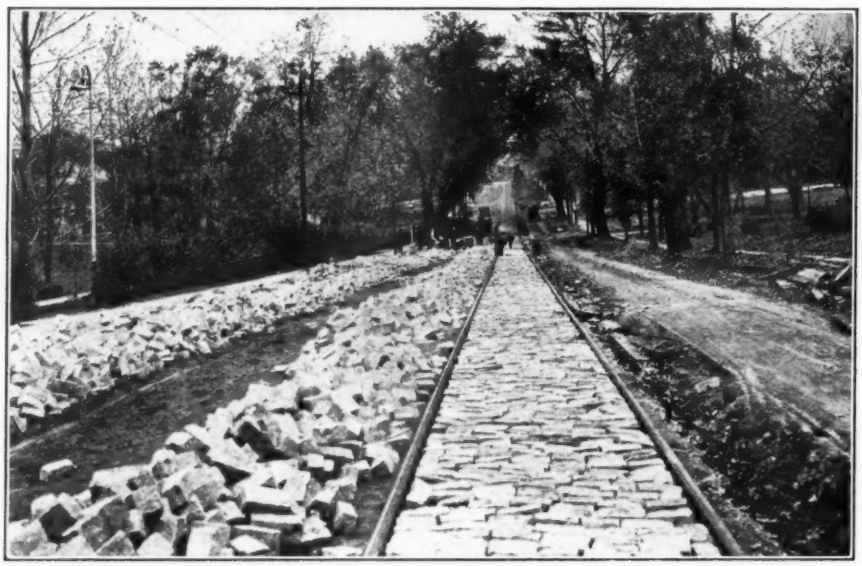
This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by any one interested. If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will be given prompt attention.

New York, Chicago, Philadelphia, Boston, St. Louis, Cleveland, Cincinnati, Pittsburgh, Detroit, New Orleans, Birmingham, Kansas City, Minneapolis, Dallas, Nashville, Syracuse, Salt Lake City, Seattle, Peoria, Atlanta, Duluth, Milwaukee, Bangor, Washington, Johnstown, Lebanon, Youngstown, Toledo, Columbus, Richmond, Latrobe, Bethlehem, Elizabeth, Buffalo, Baltimore, Omaha, Jacksonville, Houston, Dorrat

THE BARRETT COMPANY, Limited: Montreal, Toronto, Winnipeg, Vancouver, St. John, N. B., Halifax, N. S.

The Barrett Company

tion of asphaltic filler sufficient to fill the voids in the pebbles. Third application consisted of a flush coat over the entire surface of the pavement, completely filling all joints, and leaving a light coat of the asphalt on top of the blocks. A ¼-in. covering of dry pebbles passing a ¼-in. and retained on a ⅛-in. screen was then evenly applied to the surface and well rolled into it with a tandem roller. This completed the pavement, which was immediately opened to traffic.



GRANITE BLOCK PAVEMENT CONSTRUCTION IN CINCINNATI, OHIO.
View Illustrates the Laying of the Block, the Applicatfon of the Texaco Asphalt Filler, the Completed Pavement, Turned Over to Traffic and the Grading of the Street, All Without Delay to Traffic or Street Car Service.

The object of the above construction was to secure a granite pavement free from expansion and contraction trouble, in which the joints will remain filled with a material that will wear even with the pavement.

The width of the street is 40 ft. between curbs, and in order to avoid closing the street to traffic or disrupting the street-car service, one-half of the pavement was laid at a time.

The work was done by the Kirchner Construction Company, of Cincinnati, O., Superintendent Quill in charge, and under the personal supervision of Mr. Frank Shipley, Division Engineer of the city of Cincinnati.

RECORD MILEAGE OF CONCRETE ROADS BUILT IN PENNSYLVANIA

The State Highway Department of Pennsylvania, during the 1920 construction season, built approximately 410 miles of concrete roadway 18 ft. in width. This is a world's record for one season for this type of highway. In 1919 the Pennsylvania Highway Department completed 253 miles of concrete roadway.

The maintenance forces of the State Highway Department during 1920 entirely resurfaced 377 miles of macadam highway and surface treated 1,480 miles of the same type of thoroughfare. In all, the forces of the department maintained 9,503 miles of roadway. Of this mileage, 463 miles were in boroughs and on state-aid roads.

Illinois made the closest approach to the State Highway Department of Pennsylvania in the 1920 construction of highways of a durable type, having put down approximately 339 miles of concrete during the season of 1920.

The Pennsylvania Hig[illegible] Department now has under construc[illegible] proximately 350 miles of concrete, [illegible] completion of which was impossible in [illegible]0 because of the lateness of the season. The department plans the awarding of contracts for an additional 350 miles of concrete roadway early in 1921, and hopes to be able to complete not less than 600 miles of durable highway in this year.

During 1920 the Pennsylvania Highway Department was somewhat handicapped through lack of materials and because of the great transportation difficulties.

WATER WORKS SECTION

DAYTON TO ADOPT A COMPLETE RESERVOIR AND STAND-PIPE SYSTEM

"The city of Dayton, Ohio, is practically ready to adopt a complete reservoir and standpipe system," writes H. C. Wight, Superintendent Division of Water, in a letter to Municipal and County Engineering.

"Our pumpage is practically 17,000,000 gals. per day, of which 3,000,000 is pumped to the hilltops with a pressure of 350 ft. at the pumping station, the rest of which goes to the center of the city and leaves the station at a pressure of 200 ft. In 1916 we completed a 900,000-gal. standpipe on the North West high-pressure service. We have secured the site for a second standpipe in the South East high-pressure territory, and hope to duplicate this installation during 1921. In 1918 we completed a 10,000,000-gal. concrete covered reservoir on the low-pressure service. On Jan. 10, 1921, we received bids on a second low-pressure reservoir of 10 to 15-million-gallon capacity, the size depending on the price submitted, inasmuch as this will be the second of a series of four reservoirs planned for the city of Dayton. We are leaving the question of the formal contract largely to the bidders and received proposals on either lump sum contract, or on the cost plus fixed percentage basis, our idea being to get the best possible bids for the city of Dayton, and we are not sure but that this can only be secured from an open letting which will suit the customs of all who wish to compete.

"It is our desire to complete this reservoir before the dry period, which usually occurs in July and August. We believe it is possible when this reservoir and standpipe are in operation to supply the city of Dayton for 24 hours with the pump station out of service, or for 48 hours with the operation of our auxiliary station, which was completed during the past summer. This, of course, gives an additional feeling of security, which means much to the operating man who knows he has a margin of safety ahead of him."

NEW REINFORCED CONCRETE WATER TOWER, RESERVOIR AND CENTRIFUGAL PUMPING PLANT FOR THE CITY OF ALBERT LEA, MINN.

By S. von Mehren, Engineer in Charge of Construction, with J. H. A. Brahtz, Consulting Engineer, 409 Metropolitan Bldg., St. Paul, Minn.

In the design and construction of the water works improvements recently completed for the city of Albert Lea, Minn., are incorporated several new ideas, and it is believed that a short review of the main features will interest readers of Municipal and County Engineering.

The improvements consist of a new concrete water tower of 125,000 gal. capacity, replacing an elevated steel tank of approximately the same capacity; a new 1,500,000-gal. capacity concrete reservoir, and a new electrically driven pumping plant, replacing the steam driven pumping station.

Reservoir and Tower

The only suitable location for the reservoir and tower was an area about 120 ft. square, owned by the city, and in close proximity to the pumping station. To make this limted space sufficient for both tower and reservoir it was necessary to place the tower inside the reservoir. To design the 108-ft. diameter reservoir bottom strong enough to support the 145-ft.-high concrete tower, with its 500 tons of water load concentrated in the center of the plate, and at the same time make this plate continuous and prevent it from cracking, was, owing to the indeterminate nature of the problem, an engineering feat both difficult and laborious.

A careful investigation of the compressibility of the subsoil under loads approximating those imposed by the structure was carried out. The subsoil was found to compress very closely in proportion to the superimposed loads and the necessary depth of the bottom plate and the reinforcement of it were determined by the theory of elasticity. The depth of this slab within 20 ft. radius from the center was made 18 ins., tapering to 12 ins., the minimum thickness at the circumference

The diameter of the bottom plate is 108 ft., of the reservoir 100 ft., and of the tower 30 ft.

To accommodate the use of slip forms in the construction of the walls of the reservoir and the tower, these were made of uniform thickness, the reservoir walls 12 ins. and the tower walls 6 ins. The tower walls were strengthened with 8 symmetrically placed piers, 3 ft. x 1 ft. 3-in. section throughout, built monolithic with walls. Both the wall piers and the walls of the tower were securely anchored to the bottom plate and reinforced below the level of the reservoir roof, to withstand full water pressure from both inside and outside. This portion of the tower therefore serves as an integral part of the main reservoir as well as an auxiliary reservoir, in which all valves necessary for the operation of the tank and the reservoir are installed, so as to give easy access in case of breakdowns. It can be isolated from the main reservoir by means of a sluicegate when cleaning or repairs are necessary.

To construct the main reservoir wall monolithic with bottom slab was impractical. As already mentioned, the use of slip forms in the construction of the reservoir had to be considered in the design, and consequently the thickness of the reservoir wall was made uniform throughout the entire height. To have retained the thickness necessary at the bottom of the wall, about 18 ins., if monolithic construction were adopted, up to the roof level, would have increased the cost of the structure considerably. Expansion joints were therefore specified at the bottom and the top of the reservoir wall, i. e., between bottom slab and wall and roof slab and wall. The latter was necessary on account of the expansion and contraction of the roof slab. The expansion joints consist of three alternate layers of asphalt and burlap, and this construction has proven absolutely leak-proof against the 26-ft. head of water.

Before asphalt for expansion joints was decided upon it was, together with other materials under consideration, submitted to the following test: A concrete cylinder of 2 ft. diameter x 2 ft. high x 3 ins. thickness of wall, and closed at one end with an ⅛-in. thick iron plate tapped for a ½-in. pipe, was constructed. The material to be tested was placed at the required thickness on a level concrete slab, and the open end of the cylinder was pressed against the layer and loaded until the compression per square inch was the same as that which would be exerted by the wall of the reservoir. Water was then

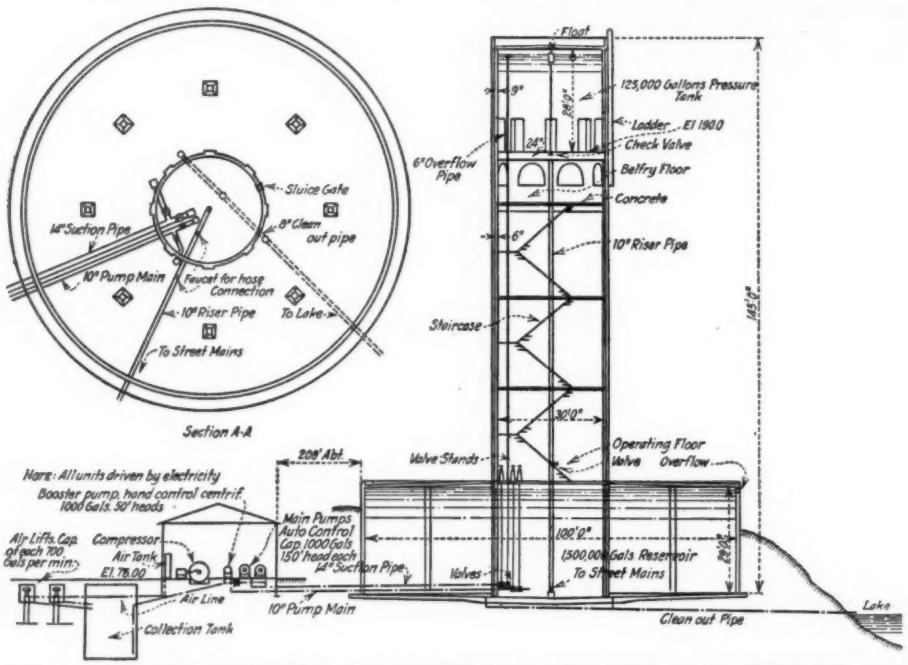
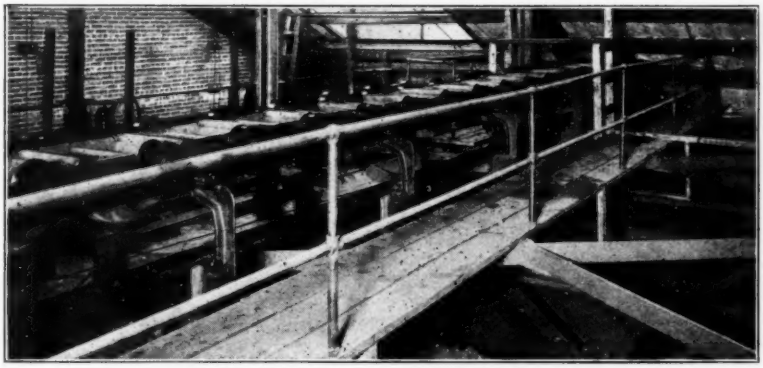


FIG. 1. SECTION OF TOWER AND RESERVOIR AND THE NEW ELECTRICALLY DRIVEN PUMPING PLANT AT ALBERT LEA, MINN.

WEBSTER



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pumped into the cylinder through the ½-in. pipe until the pressure gage registered the desired pressure. Besides asphalt, sheet lead and raw cotton fibers were tested. Cotton proved to be absolutely unsuitable, but lead and asphalt

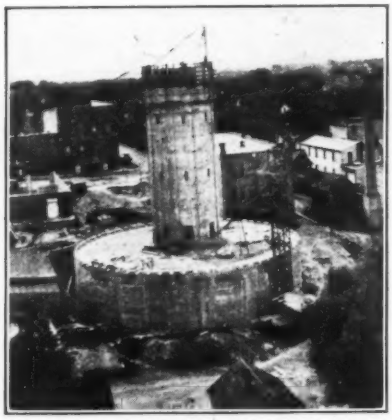


FIG. 2. RESERVOIR COMPLETED, TOWER UNDER CONSTRUCTION, ALBERT LEA, MINN.

gave satisfactory results, and asphalt, being the cheaper and easier to place, was adopted.

The roof of the reservoir is an 8-in. thick reinforced concrete slab supported between walls of reservoir and tower by beams and eight columns. Inside the tower the roof slab serves as a floor for the operating chamber. A wooden staircase inside the tower connects the operating chamber with the belfry floor, situated 12 ft. below bottom of the pressure tank. The tower walls are discontinued 4 ft. 6 ins. above belfry floor and semicircular arches built over openings between piers for architectural effect.

The bottom of the pressure tank is a 24-in. thick reinforced concrete slab built monolithic with piers and tank walls, which are 9 ins. thick between piers.

In the original design an expansion joint between the walls and the bottom of the tank was contemplated. However, owing to the fact that even a slight seepage would be very objectionable and maintenance of the expansion joint very difficult, asphalt was not considered a very desirable material to be used in this exposed position. It was therefore decided to redesign the tank for monolithic connection between the walls and the bottom. The considerable bending movement was taken care of, without changing the appearance of the structure and without increasing the thickness of the walls, merely by making the thickness of the piers 3 ft. 6 ins. throughout a height of 9 ft. The roof of the tank is a 7-in. thick reinforced concrete slab.

Concrete Mixtures and Quantities

The following concrete mixtures were used in the structure: 5,400 cu: yds. of 1 cement to 2¼ sand to 4 rock in reservoir bottom, roof slabs and tower, and 800 cu. yds. of 1 cement to 1¾ sand to 3 rock in reservoir wall and pressure tank. The cement used totaled 1,750 bbls. and the reinforcement 114 tons. The excavation, mostly gravel, totaled 5,400 cu. yds.

Electrically Driven Centrifugal Pumping Plant

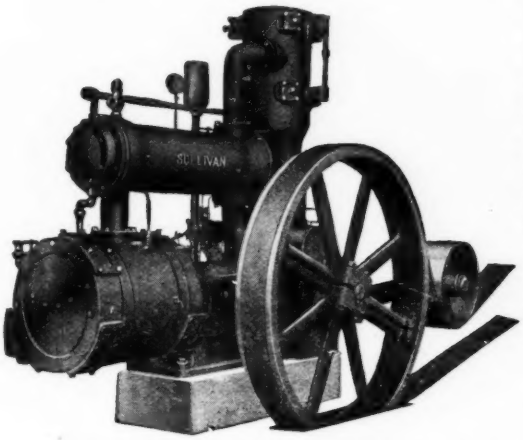
The water supply of the city of Albert Lea is drawn from two 12-in. artesian wells about 1,200 ft. deep, which tap the water-bearing stratum known as St. Peter sandstone. Previous to building the reservoir the flow of the wells had been considered sufficient for the needs of the city, although during the summer it was often necessary to restrict the water consumption. Two steam-driven pumps delivered the water to mains against a 55-lb. pressure controlled by an elevated steel tank. Shortly after the construction of the reservoir was commenced the City Council decided to electrify the pumping plant and to boost the flow of the wells and instructed the consulting engineer to prepare the necessary plans and specifications. After an investigation it was de-

FIG. 3. RESERVOIR AND TOWER COMPLETED, ALBERT LEA, MINN., WATER WORKS.

cided to eliminate the old steam plant and install the following new equipment:

Air-Lift Equipment

1. Two air lifts, each of 700 gals. per minute capacity. These are 5-in. standard Sullivan air-lift pumps. The discharge is against umbrella tops placed in concrete



SULLIVAN ANGLE COMPOUND AIR COMPRESSOR OF TYPE INSTALLED AT ALBERT LEA, MINN.

pits, from which the water gravitates to the collector tank.

2. One two-stage compressor, 120 lbs. per square inch, driven by a 50-H.P. electric motor, hand controlled, for operation of air lifts. The compressor is a 14x8¾x 10-in. Sullivan angle compound.

3. One single stage volute centrifugal pump, capacity 1,000 gals. per minute against 50-ft. head, driven by a direct connected 15-H.P. motor, hand controlled, for pumping the water from the collector tank to the reservoir.

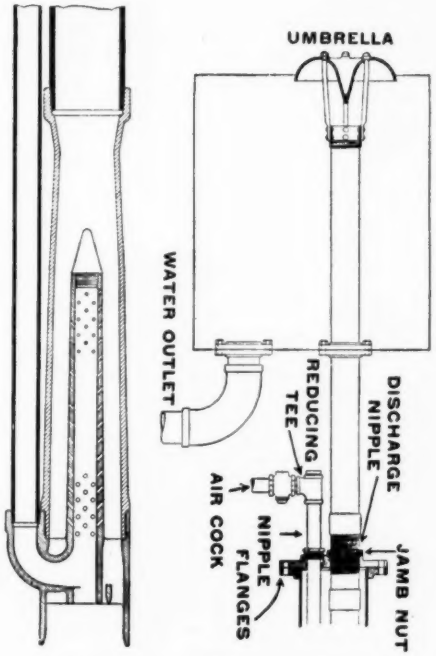
4. Two 2-stage diffuser centrifugal pumps, capacity of each 1,000 gals. per minute against 150-ft. head, driven by two direct connected 50-H.P. electric motors, automatic control, for pumping the water from the reservoir into mains and pressure tank.

The two 1,000-gal. pumps are so installed that they can pump as well in parallel as in series. It is thus possible, in case of fire, to double the pumping capacity or the pressure. A check valve in the bottom of the tank automatically cuts off this as soon as the pressure exceeds the limit, 65 lbs., controlled by the tank. Emergency suction pipe is also installed from pumps to collector tank, so that when the reservoir is empty the pumps can draw from the wells without using the booster pump.

The daily operation of the new system is, as far as practical, based upon automatic control as seen from the foregoing. Manual operation is only required for operation of air lifts and booster pump and in case of fire. This arrangement is essential with regard to the air lifts, the operation of which is only necessary during summer, when the flow of the wells is insufficient for the demand, the aim being to use the air lifts only when needed. The booster pump was installed, in spite of the fact that the air lifts might have been used for furnishing the water direct to the reservoir, because of higher operating efficiency.

Cost

The total cost of the concrete structure was $44,000, and the work was done by McManis & Tarnoski, of St. Paul, Minn.



SULLIVAN STANDARD AIR LIFT PUMP AND UMBRELLA TOP, WITH CASING FLANGES AND CONNECTIONS OF TYPE USED AT ALBERT LEA, MINN.

The cost of the new pumping equipment was $26,000; of the piping, valves and other equipment necessary for the operation of reservoir and tank, $15,000; these were installed by Wm. Danforth, of St. Paul, Minn. Mr. J. H. A. Brahtz, of St. Paul, Minn., was consulting engineer.

COAL AND ASH HANDLING SYSTEMS FOR POWER PLANT BOILER HOUSES

By W. F. Leggett, 2017 Sherman Ave., Evanston, Ill.

Almost the first sentence passed upon primitive mankind was the edict that he must earn his bread by the sweat of his brow, and for thousands of years no real attempt was made to set aside the judgment. In less progressive localities it is still observed with undiminished vigor, although the effect of synchronizing effort with perspiration has made the personnel of many a job 100 per cent. kaleidoscopic, and the "sweat of honest toil" is the mark of a decadent system. Mankind gradually learned that sustained labor could not be regulated by ukase, and it was this feeble ray that developed the wheelbarrow and hod—neither of which is quite extinct—but with the advent of these simple substitutes for human brawn a germ of endeavor developed, which became the genesis of present-day material-handling systems.

When applied to municipal and industrial power plant boiler houses, coal and ash-handling systems should be characterized by directness and simplicity. Therefore many laymen infer that a series of standard specifications should be made to cover average conditions, thus enabling a purchaser to select material-handling equipment in much the same manner that he chooses a talking machine or an automobile. It is true that there are certain combinations of equipment that are adaptable to a large number of power plant boiler houses that burn approximately the

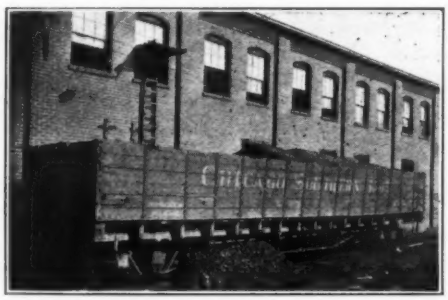


FIG. 1—RECEIVING COAL IN TRACK HOPPER.

same quantity of coal, but it is equally true that each installation should be a law unto itself, warranting special study by experienced engineers, to the end that the equipment will be correctly designed and in proper articulation to the system as a whole.

In all essentials the installations described in this article are the average types of their kind. They include a track hopper, a feeding device from hopper to bucket elevator, methods for carrying coal

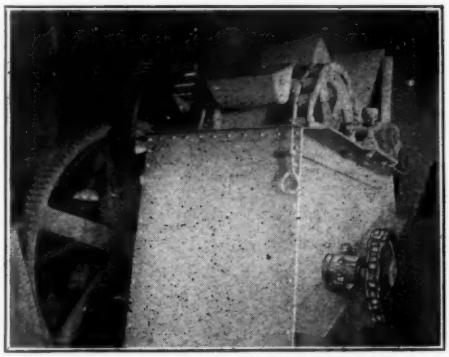
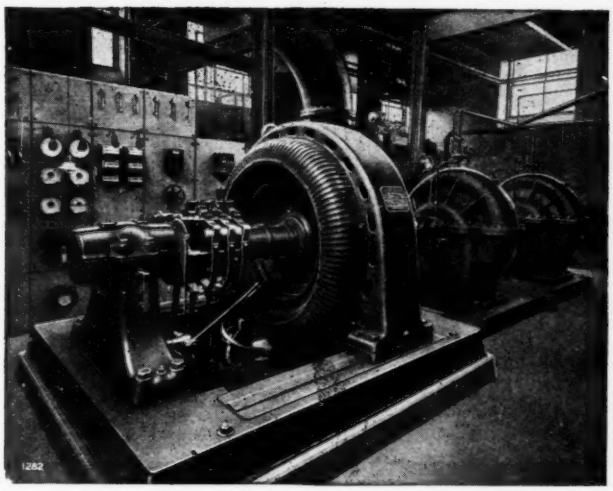


FIG. 2—ELEVATOR HEAD WITH TOP CASING REMOVED.

from the elevator and distributing it to either a single bunker or series of bunkers. It is, however, important that an expert decide whether the feeder be a reciprocating steel apron or rotary type; whether the elevator has centrifugal discharge or continuous bucket; whether the distributing conveyor be belt, screw or scraper type—with the possible substitution of a V-bucket or a pivoted bucket type for both elevator and conveyor. These factors are always governed by local conditions, and unless two boiler houses are exact duplicates in capacity, equipment and location of coal supply—a condition that is most rare—each installation will differ in some more or less important manner from its predecessor.

A Typical Chain Elevator and Screw Conveyor Installation

A typical belt and screw conveyor installation begins with the usual concrete or steel track hopper, shown in Fig. 1. Attached to the hopper outlet is the feeder which supplies the inclined elevator, the feeder being a reciprocating plate type so well adapted to handling slack coal, especially when the distance between the hopper and the elevator is comparatively short. The feeder plate is usually about 5 ft. in length, having a variable stroke, and carries forward a load of coal 16 ins. wide and 9 ft. long. This plate is propelled on rollers which are driven by a forged steel connecting rod and crank, that crankshaft being driven by means of a chain from the foot shaft of the ele-



Two 24 in. De Laval Centrifugal Pumps handling 30,000,000 gal. per day against 250 ft. head and driven by a three-phase slip-ring induction motor.

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MONTH	PUMPED GALLONS	HOURS RUN	TOTAL HEAD	EFFICIENCY
	1918			
June	931,900,000	689.5	248.74	80.9
July	926,850,000	688.0	250.49	81.5
August	938,650,000	696.0	249.64	81.3
September	842,150,000	623.0	249.91	81.6
October	789,650,000	584.5	251.11	81.7
November	579,350,000	431.5	253.46	82.1
December	789,850,000	603.5	259.66	83.2
	1919			
January	801,350,000	608.5	259.38	83.6
February	763,700,000	592.5	261.89	83.3
March	94,900,000	74.5	266.62	84.0
April	934,000,000	679.0	248.67	82.8
May	968,400,000	724.0	251.37	82.4
Totals	9,360,650,000	6994.5	3050.94	988.4
Monthly average (year ending May 31st, 1919)	780.054,166.67	582.785	254.245	822.36⅔
	JUNE, 1919			
	942,950,000	700.0	251.09	82.5

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(88)

vator. Fig. 2 shows a detail of the elevator head, with cap and casing removed. The buckets are malleable iron, 16 ins. wide, and are attached to parallel strands of combination chain by means of angle iron clips. Because of the incline the chains run on angle iron guides installed the entire length of the casing on both the carrying and the return runs, the only exception being at the point where the buckets pass over the head and deflector shafts employed in slow moving, perfect discharge elevators. The buckets travel at a speed of 115 ft. per minute, and in order to prevent coal from spilling and falling over the head shafts as the buckets turn, the sprockets are connected to a steel drum, Fig. 2, which carries the spillage into a spout. In the case of faster elevators, when the lineal travel and size of headwheel are more nearly related, the bucket loads are discharged directly into the spout, and no drum is necessary.

Two screw conveyors are used to distribute the coal into the boiler bunkers, each conveyor being of equal length, and both being driven by a single chain from the elevator head shaft. When desired, the coal can be conveyed to a separate storage bin. There is always a possibility that slack coal may not be available, and to meet this condition provision can be made for a crusher for use with run-of-mine coal. When used, the crusher is installed between the feeder and the elevator, the coal passing over a screen through which the slack is delivered directly to the elevator, the remaining lumps traveling through the crusher to the elevator.

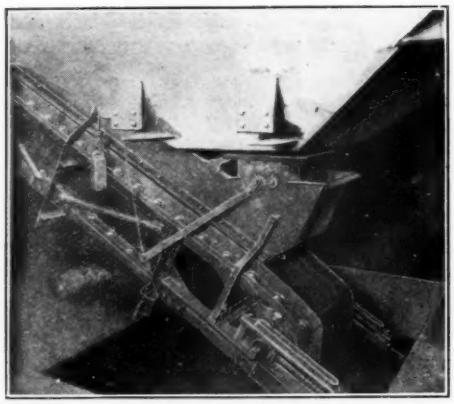


FIG. 3—CONVEYOR BENEATH TRACK HOPPER.

No equipment for handling coal mechanically in a more simple or direct manner can be designed for power plants of average size. The equipment described will easily handle a rated capacity and demonstrates the fact that the mechanical handling of coal can be accomplished without the installation of complicated machinery. Not only is such equipment comparatively inexpensive, but it is a real

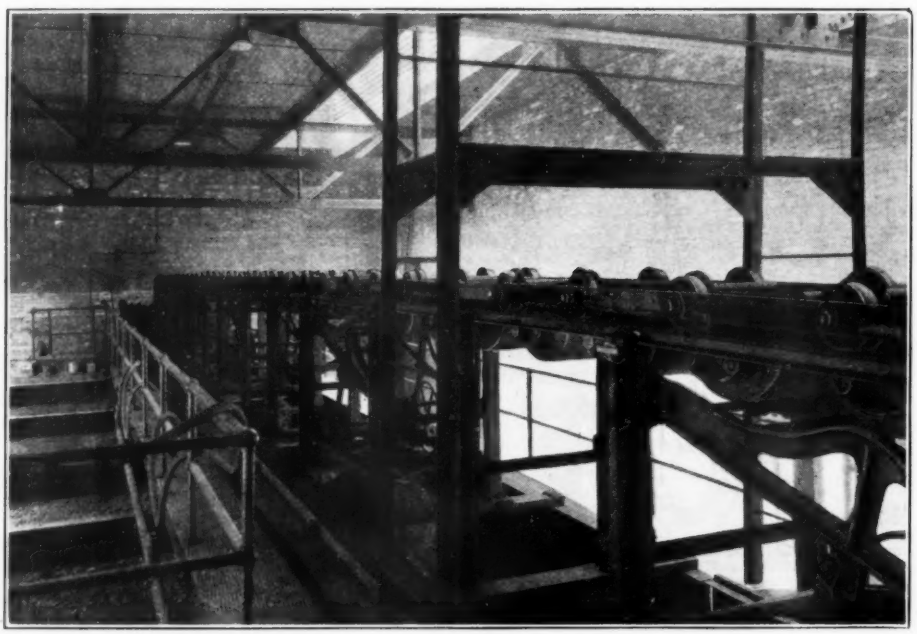
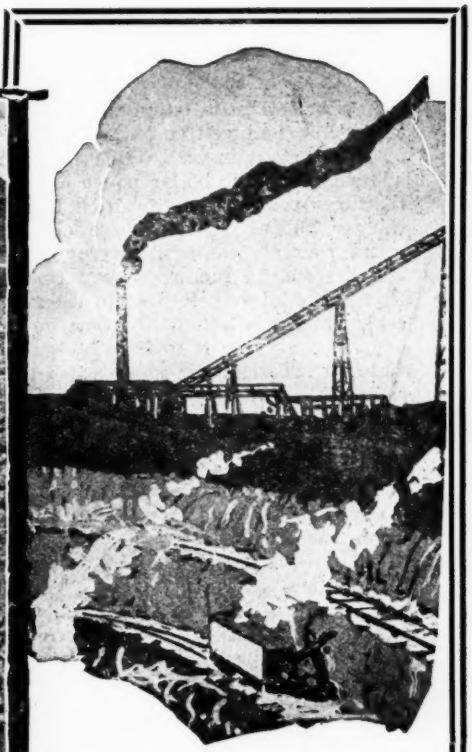


FIG 4—TOP RUN OF CARRIER FROM DRIVE GEAR END.



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asset in that it will release coal handlers and stokers for other work.

A Typical Coal and Ash-Handling Installation

In a typical installation which includes ash removal as well as coal handling, the coal is brought in cars which are usually switched into the boiler house extension, in the upper portion of which is placed the ash hopper. Under the tracks is the usual concrete hopper, varying in size, which feeds an inclined apron conveyor, Fig. 3, the latter being set to receive the coal, which is discharged from the track hopper, conveying it to the crusher, from which it is discharged to a pivoted bucket carrier, the buckets of which pass beneath the crusher. In case the coal requires no crushing it can be by-passed to one side of the crusher, to a spout, and discharged directly into the bucket carrier. Just past the crusher the carrier makes an upward turn, and at a proper height it again turns for the upper horizontal run over the bunkers, shown in Fig. 4. Above each bunker is a tripper device which is arranged for raising and lowering, by means of a geared toggle mechanism controlled by a hand wheel. When in the down position the trippers are inactive and permit the buckets to pass without interference, but when raised they cause the buckets to tilt as they pass, thus dumping their contents into any selected bunker. Placed at the distant end of the top horizontal run is the drive for the carrier, so located that it is at the farthest point of possible load, thus placing the system in tension at all times. Passing the drive sprockets, the buckets turn for the vertical descent along the end wall, traveling past the boilers in the basement. Here another turn starts the lower horizontal run to meet the ash hoppers, Fig. 5, which are located below the boiler furnaces. When not receiving coal, the bucket carriers may be used for the disposal of ashes, these being dropped directly into the buckets from ash hoppers. A system of spouts, Fig. 5, may be connected with the bucket carrier at this point and through them floor sweepings and other rubbish may be carried away.

Ashes and refuse are conveyed past the crusher until the buckets reach a tripper placed above a receiving hopper spout, through which they are delivered to an incline conveyor which carries them to an ash storage bin in a wing of the building, where they remain until dropped into cars for removal.

This system provides a most complete method of coal handling and ash removal, and particularly applies to power plants of medium size, handling a fairly large flow of coal.

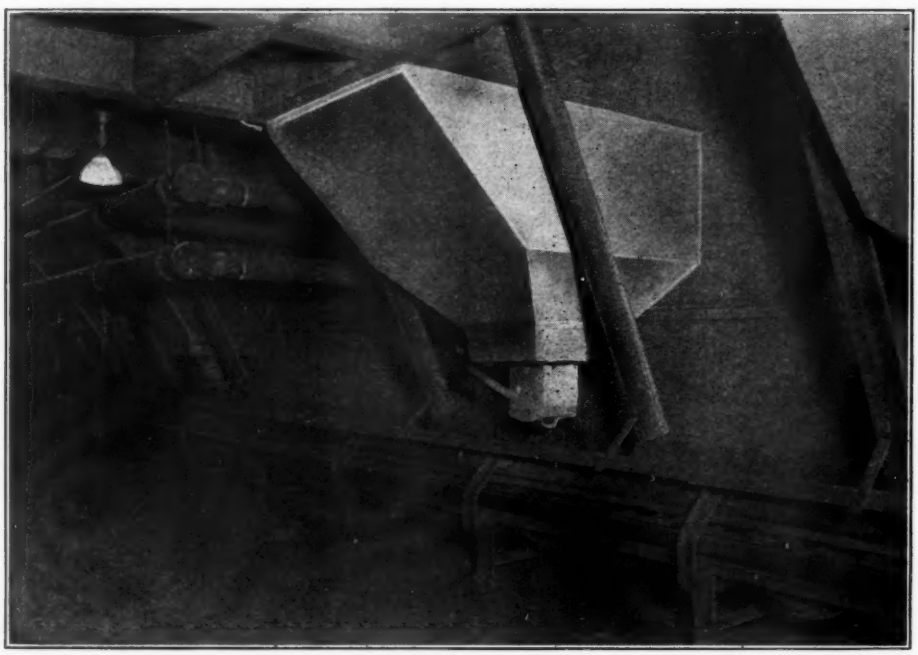


FIG. 5—BOTTOM RUN OF CARRIER UNDER ASH PIT HOPPERS.

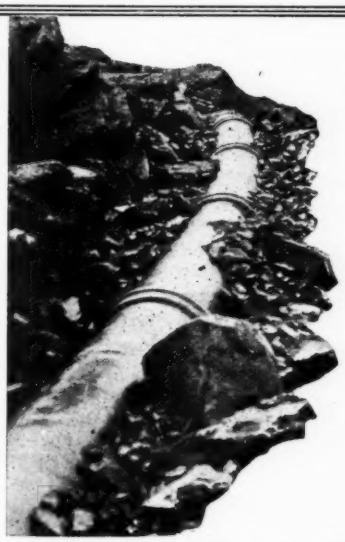
SOUND FINANCIAL BASIS FOR MUNICIPAL WATER PLANTS

By George W. Fuller, of Fuller & McClintock, Consulting Engineers, 170 Broadway, New York, N. Y.

For five years prices of labor, materials and supplies have been high and the cost of water works operations has been correspondingly increased above the so-called pre-war normal. The cost of service rendered by various privately owned utilities, in those States where regulatory commissions have jurisdiction over them, has been increased. In some instances rates have been increased several times, as is true of the steam railroads, with approval of the Interstate Commerce Commission. But most city-owned water plants have increased their rates of charges but little, if at all.

Continuance of this policy has caused so much deferred maintenance and replacements, with such a resulting stress as to operating conditions, that some water plants should not or cannot so continue much longer. Although some recession of prices is at hand, there are many cities which should consider putting their water plants at once on a sound financial basis. At Buffalo, Commissioner Andrews, of the Water Bureau, and the writer investigated this question, with the result that the City Council recently adopted a new schedule of rates that will increase the gross revenue of the bureau over 30 per cent.

Incident to those investigations of the financial policies of Buffalo and some other lake cities it was found that the local deficits in earnings were caused by a widely different financial program adopted by the Buffalo Water Department than at several other cities. Thus at Buffalo it was the custom for years to issue bonds to pay for all pipe extensions and for all other improvements. In fact, no betterments have been paid for out of earnings during the past ten years, and water bonds at maturity have been taken care of frequently by issuing new bonds secured by the taxing power of the city. The outstanding water bonds at Buffalo amount to more than 72 per cent. of the plant investment. At Milwaukee, Chicago and Erie the bond issues amount to about 2 per cent. or less; at Toledo and Detroit the bonds are less than 25 per cent., while at Cleveland they amount to about 50 per cent. and at Duluth to about 65 per cent. of the plant investment. The above does not tell the whole story, because the cost



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of ordinary pipe extensions at Milwaukee and at Cleveland is assessed against the property benefited.

At Buffalo the report on rates was founded on the viewpoint that the Water Department should be conducted as a self-supporting business enterprise for the benefit of the citizens. On the one hand it should not create any demands on the tax rate or general bonding program of the city except for fire-protection service. On the other hand a surplus account should not be created from earnings so as to provide more than a reasonable contingent reserve account or what is reasonable in anticipation of the cost of large betterments such as all plants require at intervals.

Sound policy demands that before rates are increased or deficits are charged against the tax budget of the city, every reasonable effort should be made to effect economies through the reduction in needless pumpage, by reduction in the number of the operating force if practicable, by the most advantageous purchase of materials and supplies, and by developing the efficiency of management to a maximum.

With all these steps taken and with a recognition at this late date that it is impracticable at Buffalo to assess the cost of future pipe extensions against the property to be benefited, it was necessary to draw a conclusion as to whether needed revenue should be obtained by increased water rates, by obtaining funds from the tax budget of the city, that has abundant ways of otherwise spending its income, or by the sale of city bonds secured by the taxing power of the city. The latter custom was considered inadvisable because its adoption in the past had made it necessary to apply in 1919 more than 42 per cent. of the total receipts of the local Water Department to interest and sinking fund payments, even with some of the bonds carrying no sinking fund provision. Furthermore, uncertainties as to ability to market bonds made that method for the time being a precarious one.

After due consideration of all aspects of the Buffalo proposition it was decided to increase the water charges more than 30 per cent. and to continue activities in reduction of waste and thus pave the way for a future filter plant. The total revenue estimated to be required for the current year was a little more than $2,250,000, or about $4.50 per capita per year, equal to about 1¼ cts. per inhabitant per day. The first quarterly collections under the new rate schedule were made with very little complaint, and the Water Bureau at Buffalo, for the first time in recent years, has been placed upon a sound financial basis.

DETERIORATION OF INSULATION RESISTANCE IN THE HIGH PRESSURE FIRE SERVICE MOTORS, CITY OF NEW YORK

By William W. Brush, Deputy Chief Engineer, Bureau of Water Supply, Department of Water Supply, Gas & Electricity, Municipal Bldg., New York, N. Y.

The seasonal lowering to a marked degree of the insulation resistance of the electric motors installed in the pumping stations connected with the high-pressure fire service systems of the boroughs of Manhattan and Brooklyn, has occasioned concern as to the safety of operation of these motors. Careful watch has been kept of the resistance of the motors, especially during the past two years, and this record, together with an outline of the experiments made, may be helpful to others who have electrical equipment subject to similar conditions. A brief outline of the equipment and its history will first be given.

High-Pressure Fire Service Station Equipment

There are four pumping stations serving the high-pressure fire service system of the city of New York, exclusive of the small Coney Island system. Two of these stations are in Manhattan and two in Brooklyn. Each Manhattan station has six 5-stage centrifugal pumps driven by Allis-Chalmers 6,600-volt induction motors. The delivery capacity of each unit is 3,000 gals. per minute against 300 lbs. per square inch. Five of the machines were installed in 1908 and one in 1911. The Brooklyn installation consists of General Electric 6,300-volt motors, with pumping units similar to those in Manhattan, all installed in 1907. There are five of these pumps in the main station and three in the reserve station.

Location of Stations

The Manhattan stations and the main Brooklyn station are located on the river front, so that salt water could be used in an emergency, while the reserve Brooklyn station is about one mile from the river. The position of three of the stations exposes them to humidity above the normal,

and in the Brooklyn main station the floor level is equivalent to one story below the street level, with a damp cellar below, thus further increasing the moisture in the air.

System of Operation and Maintenance

In Manhattan one pump is started when an alarm is received within the territory covered by the station, and 125 lbs. per square inch is maintained until the pressure is either increased or the station closed down due to the extinguishment of the fire. The alarms for each station average somewhat less than two per day. Every day each motor that is not run on an alarm is operated as a test for five minutes.

In Brooklyn, up to about the end of 1917, the motors were started on alarms and daily tests made similar to those in Manhattan. The Catskill supply was introduced in 1917, and since then the direct Catskill pressure in the high-pressure mains has given the firemen about 100 lbs. per square inch, which is ample for all first alarms. As there is less than one alarm per month where more than this pressure is called for, the motors and pumps are now mainly run for the five-minute daily test.

Failure of Insulation of Brooklyn Motors

A prolonged fire in Brooklyn on Aug. 20, 1917, required the output of one motor in the main station. The first one on the service ran for 48 minutes and then burned out. A second motor lasted for 42 minutes, a third for 66 minutes, and a fourth finished the run by operating for 45 minutes without burning out. An examination showed the insulation on the stators had failed and these were rewound by the manufacturers in about four months' time at a cost of $5,300. On test, one of the motors showed a short circuit in its rotor which required two months to repair and cost over $2,000.

Steps Taken to Prevent Further Failures

To prevent, as far as possible, further trouble, the motors were thereafter run for 30 minutes only and then a fresh motor introduced in service. Tests made on the two undamaged machines shortly after the failures, showed an insulation resistance of 1 to 1.8 megohms when the motors were cold. These machines were then heated by using direct current sent through the stator coils, and after 20 hours of this treatment the resistances warm were from 0.7 to 1.8 megohms, while when cold the resistances had increased to from 4 to 6 megohms.

After this baking or heating process had been continued for about one week, the resistance cold had risen to from 8 to 10 megohms.

Result of Resistance Tests

The resistance tests were continued and showed relatively high results during the period of the year when the buildings were artificially heated and low results in the summer season, especially so during very humid spells. Thus, during nine days of rain in July, 1919, the resistance of some of the motors, both in Manhattan and Brooklyn, was as low as 0.4 of a megohm. The rewound motors in Brooklyn showed much higher resistances during the entire year than did the other machines.

The result of tests made approximately weekly showed since Aug. 30, 1920, the following results at the Brooklyn main station and at the Oliver street station in Manhattan :

MAIN STATION

Machine No.		1	2	3	4	5
Aug. 30	Megs	30	27	1	30	2¾
Sept. 7	"	40	40	2¾	35	4½
Sept. 13	"	40	30	1¾	30	3½
Sept. 20	"	100	125	5½	125	18
Oct. 11	"	100	90	6	100	10
Oct. 18	"	60	60	4	50	7
Oct. 25	"	70	70	6	60	9
Nov. 1	"	100	125	8	100	14
Nov. 8	"	100	125	8	100	20
Nov. 15	"	150	175	15	150	35
Nov. 22	"	125	150	13	125	20
Nov. 30	"	200	200	20	150	125
Dec. 6	"	200	175	15	150	20
Dec. 13	"	150	175	20	175	15

OLIVER STREET STATION

	1	2	3	4	5	6
Machine No.						
Aug. 30—						
Megs.	1.5	2.3	1.8	2.2	2.2	2.8
Sept. 7—						
Megs.	2½	3.8	2¾	3½	3½	5
Sept. 13—						
Megs.	2¼	2.8	2.8	2.9	3	3.1
Sept. 20—						
Megs.	8	12½	11	13	20	15
Oct. 11—						
Megs.	7½	9	9	9½	12½	15
Oct. 18—						
Megs.	5	4¾	4¼	4½	6	6¼
Oct. 25—						
Megs.	6	6	4½	6	8	7
Nov. 1—						
Megs.	12½	12½	10	15	20	15
Nov. 8—						
Megs.	20	15	12½	17½	17½	17½
Nov. 15—						
Megs.	30	25	22	25	26	25
Nov. 22—						
Megs.	20	12	12	16	15	18
Nov. 30—						
Megs.	28	24	22	40	30	30
Dec. 6—						
Megs.	17	15	15	22	25	20
Dec. 13—						
Megs.	18	17	18	24	25	22

During the summer season the motors were covered with canvas and the surrounding air under the canvas heated. In Brooklyn gas was used and at Oliver street hot-water coils. The temperature

under the canvas was about 11 degrees above the room temperature. Experiments in Oliver street were also made, using unslaked lime to dry the air. While these measures prevented the very low resistances shown when the motors were not protected in any way, the results were so far below those shown during the winter season that it is evident a more effective drying of the air is necessary to obtain the desired results.

It is believed that for safety at least one set, and preferably two sets, of stator coils should be kept on hand for each make of motor, and the existing coils, after removing them from the machines, treated to increase their moisture penetration resistance. Further experiments in drying the air are to be tried during the next summer season. The manufacturers and others have been consulted on this question of maintaining the insulation resistance, but no one appears to have had an experience which closely approximates the conditions herein outlined.

The high-pressure system of New York has fully met expectations and demands, but evidently the motors must now either be renewed or the insulation resistance increased to reasonably safeguard continuity of service in the future.

FEATURES OF NEW AQUEDUCT FOR BUTTE, MONTANA

Wooden stave pipe was specified for the major portion of the new Butte aqueduct, but steel pipe was specified for the portions of the line having the highest pressures. The use of oxy-acetylene welded, instead of riveted or screwed joints, and in preference to welding by other processes, is one of the important features of the project from an engineering point of view, and is the feature chiefly considered in the present article.

General Features of the Project

The project presented unusual physical obstacles. In places the line climbs abrupt slopes, threads tunnels through solid granite, and clings to sheer mountain walls. In one place a 10-horse team, used in an effort to haul a 3-ton "T," had to be abandoned and block and tackle substituted. Caterpillar tractors, motor trucks and heavy excavating machinery were in constant use. Where grades were too steep for trucks, horses were pressed into service, and where they could not negotiate the climb the caterpillars were hooked on.

The new pipeline duplicates the old line (in service since 1900) and was built to supplement, not to replace it, excepting during periods when repairs to the old line become necessary. The new line is composed partly of steel-banded redwood stave pipe, and partly of ½-in. thick, double-coated pipe, the sections being on the average 17½ ft. in length and weighing from 2,000 to 2,400 lbs., according to diameter. The wood pipe is used up to a hydrostatic pressure of 300 lbs. per sq. in. and the steel pipe for pressures in excess of 300 lbs. There are approximately five miles of the steel pipe in which the working pressures vary from 350 to 400 lbs. per square inch. In one place a grade of 38 degrees is maintained for a distance sufficient to elevate the line 400 ft., and there is a lift of 800 ft. in a distance of 3,000 ft.—from pumping plant to standpipe.

This standpipe, which is made of concrete and stands 75 ft. high, was erected at the same elevation as the "South Fork" reservoir, some nine miles distant, its function being to take up the "water-hammer" in the pipe. The water rises or falls in the standpipe with each stroke of the pump, thus equalizing the pressure on the line.

It is claimed that the pumps, three in number, are the largest ever built, and that but one pumping station in the world lifts a column of water to a greater height. The three pumps are capable of delivering 15,000,000 gals. of water every 24 hours. Besides this volume, the South Fork reservoir receives daily 1,000,000 gals. drawn from the south fork of Divide Creek, bringing Butte's total available water supply up to 16,000,000 gals. per diem.

Following are the chief elements in the completed line:

26-in. Oxy-acetylene Welded Pipe	3,674 ft.
24-in. Oxy-acetylene Welded Pipe	22,368 ft.
Total Oxy-acetylene Welded Pipe	26,042 ft.
26-in. Steel-Banded Redwood Stave Pipe	42,326 ft.
24-in. Steel-Banded Redwood Stave Pipe	71,954 ft.
Total Redwood Stave Pipe (lineal)	114,280 ft.
26-in. Gate Valves	(No.) 9
24-in. Gate Valves	" 9
24-in. Balance Float Valves	" 4
Concrete Float Valve Chambers	" 4
Concrete Weir Chamber (at Reservoir in Butte)	" 1

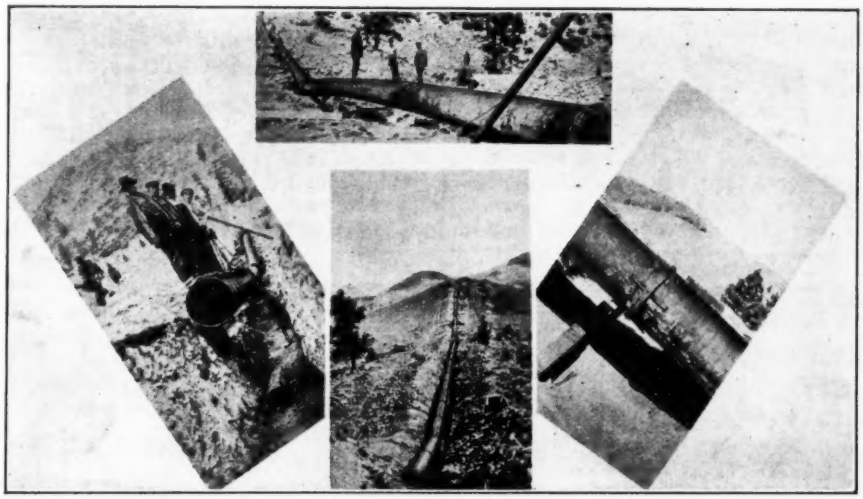
The construction of the pipeline required 1,125 tons of steel pipe, 1,750,000 board feet of redwood staves, 1,100 tons of steel bands (used on the redwood pipe) and 426,000 malleable shoes, weighing

from 6 to 8 lbs. each, for the wooden pipe construction. There were 160,000 cu. yds. of excavation, including earth, loose rock and blasting.

Why the Line Was Welded

The reason for using welded construction instead of the customary riveted or screwed connection is primarily one of efficiency, though it also resulted in a marked economy. To have secured the same strength in the joints with screwed pipe, very much heavier pipe would have been required, and if riveted pipe had been used lapping the joints would have been necessary. In either of these cases the material cost for pipe alone would have been considerably higher than it was. The labor cost of the welded construction, everything considered, was also lower than it would have been for screwed connections. Another great advantage was a greater flexibility of the welded joints, which readily yielded to conform to the contours of the trenches. Flexibility is highly important in a country where many sharp curves must be followed. Another consideration was the advantage in speed of construction—an important element in this work, where an average of 350 men were employed over a continuous period of five months. It was very important also to have the work completed in the early fall, before the rigors of winter should halt it entirely, and this might not have been possible had it been handled differently. But, were there no other consideration, the fact that the steel pipe lies embedded several feet under the surface, where the joints are exposed to seepage from rain and snow and to the attack of rust, would be conclusive in determining many engineers on using some form of welded construction, owing to the probable ultimate economy of this method of jointing.

The process employed in welding the pipe was given very careful consideration, and it was decided that oxy-acetylene welding would insure the best jointing of the pipe to stand up under the service for which the line was designed. It then became merely a matter of awarding the work to a responsible welding contractor, having standard equipment and employing competent welders. The welding was done under the superintendence of F. E. Woodbridge, of Butte and Helena, Mont. Oxweld apparatus was specially ordered for the work.



VIEWS OF NEW STEEL PIPE AQUEDUCT OF BUTTE, MONTANA, WATER WORKS FEATURING OXY-ACETYLENE WELDING.

How the Welding Was Done

The method of welding the steel pipe is interesting. Joints were lined up by means of pump jacks and held in position by steel clamps made of ¾-in. strap steel 3 ins. wide. The joints were then tacked in four places, after which the operator proceeded from any one of the tacks as a starting point. It was possible in many cases to turn jointed lengths 200 ft. long to 300 ft. long at one time, thus enabling the welder to operate continuously on top of the pipe. Where long curves were necessary many of the joints were made by the operator welding around the pipe in place, but supported on skids, thus eliminating the necessity of excavating bellholes in the solid rock, which would have been very expensive.

The curves were very numerous on this work, and the joint construction was so carried out as to distribute the bend over several connections, a small amount being allowed for each weld. This not only gave the line a graceful appearance, but reduced friction to a minimum, which is one of the great points in favor of welded construction. Owing to the fact that the pipe will carry water to its full capacity the year round, the expansion and contraction are practically nil, but as a safety measure, where the curve occurs in the line or the pipe descends or mounts an incline, additional curve is allowed to provide for a slight expansion or contraction.

Lowering Pipe Into Trench

The pipe was suspended over the ditch by 8x8-in. skids for distances of from 300 to 400 ft., and, when ready for the trench, one end was slightly raised with the pump jacks to allow removing the skids at that point, when the unsupported end was allowed to drop into the ditch. The succeeding skids were then taken out in a similar manner and succeeding sections of welded pipe were thus lowered to the bottom of the trench. In some cases there were as many as seven joints suspended between the point of the jack and the first skid, causing a total strain of approximately seven tons on one of the joints. It will be noted that one of the photographs shows four men at the end of a pipe section suspended in midair by means of a chain block placed back of the joint. The full weight of the pipe and of the four men (approximately 2,800 lbs.) comes on the joint in this case, visually indicating the great strength of a joint where properly welded by the oxy-acetylene process.

In some cases, when the wind was very severe, shelter was necessary for the flame, as air currents tend to cause oxidation. With the Oxweld blowpipe, however, in which the mixing of gases is automatically controlled, very little trouble was experienced, regardless of the weather, and the welding measured up to every inspection requirement.

It will be appreciated, of course, by those familiar with oxy-acetylene work, that it was necessary to have the metal clean and free from foreign substances and to avoid an excess of either of the gases, as the pipe in this aqueduct has to withstand heavy pressure. All of the cutting and welding operations on this project were accomplished with Oxweld equipment, exclusively.

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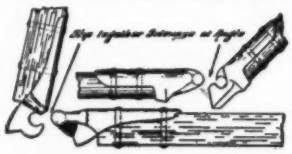

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Construction News and Equipment

MODIFICATION OF HIGHWAY CONTRACTS TO MEET PRESENT CONDITIONS

By W. R. Neel, State Highway Engineer, Walton Bldg., Atlanta, Ga.

In presenting a new form of contract, I wish to remove from the minds of every one any suggestion or thought that I have devised a form of "cost plus" under a new name. However, the "cost plus" contract, when originally drawn, embodied two fundamental principles involving fairness to every one:

First, that the owner or beneficiary should pay the cost of the improvement; second, that the contractor effecting the improvement should be fairly compensated for his efforts. Recognizing these two principles, then, we have had as a result several forms of contracts based on these fundamentals. The cost with a percentage of whatever that cost might be, to cover the compensation, commonly known as the "cost plus," is in bad repute, and certainly the results of the use of this method during the late war have given every one just cause for prejudice against it. In an effort to remove the incentive to an unscrupulous contractor to increase the cost, thereby increasing his profit, the cost plus a fixed fee was tried out and proved more satisfactory to the owner and also the conscientious contractor.

My principal criticism of the cost plus a fixed fee is that there is no incentive for the contractor to keep down the cost of the work other than a desire to secure a reputation for economical and efficient work. In public work, where it is necessary to advertise and receive bids, thereby removing to a great extent the discretionary powers of the public official in selecting the contractor, something more than the two above mentioned forms of contract are needed. In attempting to embody the two fundamental principles recognized by every one as a basis for any contract, and at the same time perfect a contract more adapted to the execution of public work, the Form "B" Contract was written.

The Form "B" Contract of Georgia

The original draft was submitted to a large number of people, such as experienced engineers and contractors, as well as legal talent of varied ability, and changed to meet those suggestions we thought worthy of consideration.

Since initiating work under this form of contract other changes have been made to perfect its weak points, and I wish it understood that in submitting this I am cognizant of the fact that it will probably be changed from time to time as experience in its use directs.

In approaching the demand for a new form of contract in Georgia, I was confronted with a constantly ascending scale of unit prices, each succeeding set of bids being a little higher than those preceding, until it was a question of either suspending the letting of new contracts or of devising a means of decreasing the cost of the work. I do not wish to place all the blame for the excessively high bidding upon the contractors; they, in turn, were under the fear and actual conditions of constantly ascending prices for material and labor, together with the uncertainty of freight rates, until no one knew where he stood nor how to bid. It was a gamble, as the old form of contract always has been, with the odds heavily against the contractor, and, as a consequence, the high bidding. Furthermore, every one was affected by the many uncertainties, and the bonding companies, realizing the greater risk, demanded of the contractor higher bidding. On several occasions contractors have informed me, after the bids had been rejected, that they were willing to submit a lower bid, but could not secure a bond if they did so.

State Assumes Risk and Costs Decrease

It therefore appeared to me that in order to meet this situation it would be necessary for the State of Georgia to carry a large part of the risk, and, briefly, the actual use of the present form of contract immediately produced the desired results in decreasing the cost of the work to the State.

The use of this form of contract does not eliminate competition. The contractor, in submitting his bid, divides it into two parts—the estimated cost and the desired compensation. In order to have an incentive to keep down the cost, the con-

tractor is allowed 25 per cent. of any saving on the estimated cost, provided it does not exceed 50 per cent. of the total compensation in the proposal, and should the cost exceed the estimate, 50 per cent. of this excess is deducted from the compensation, with the provision that the compensation must not be reduced more than 75 per cent. Therefore, the contractor is assured of at least 25 per cent. of the compensation, as shown in his bid, for which he must furnish at his expense a superintendent and any overhead expense, such as the maintenance of his general office. It is calculated that the 25 per cent. will allow the contractor to break even, with no loss other than that of his time. The contract also provides for a machinery and equipment rental, a form being provided which must be filled out and which forms a part of the contract cost of work. However, the rental schedule is fixed, and only the interest on the value of the equipment is allowed, plus a fair compensation for depreciation, insurance and estimated repairs. In this way no profit can be made other than that shown as compensation, and this amount varies with the skill and zeal used in prosecution of the work. Thus the minimum compensation obtainable by the contractor will be 25 per cent. of the compensation shown in the bid, and the maximum will be the compensation shown in the bid plus an additional 50 per cent. of this amount. If the contractor should be so fortunate, the owner should not begrudge him this additional compensation, as additional compensation means a saving of 75 per cent. to the owner.

Features of the Contract

The cost of the work is paid by the owner, who is required to pay promptly all bills, in order to take advantage of any cash discounts. A bonded accountant in the employ of the owner makes up payrolls and supervises the paying of all labor, etc. All materials are purchased by the purchasing agent of the State Highway Department, and the prices for all materials, f. o. b. railroad siding, are included in the proposal. In this way, the only financing required by the contractor is in purchasing equipment pertaining to the job and in paying the salary of his superintendent. This has resulted in the immediate delivery of all necessary materials for the vigorous prosecution of the work as soon as practicable after the awarding of the contract.

The contractor is called upon to furnish the necessary equipment and a skilled organization, properly directed by an experienced and efficient superintendent. The elimination from the requirements of the contractors of practically all financing results in a considerable reduction in the compensation demanded by them, so that this is practically net profit to the State under this form of contract.

Contract System Preferred to Force Account

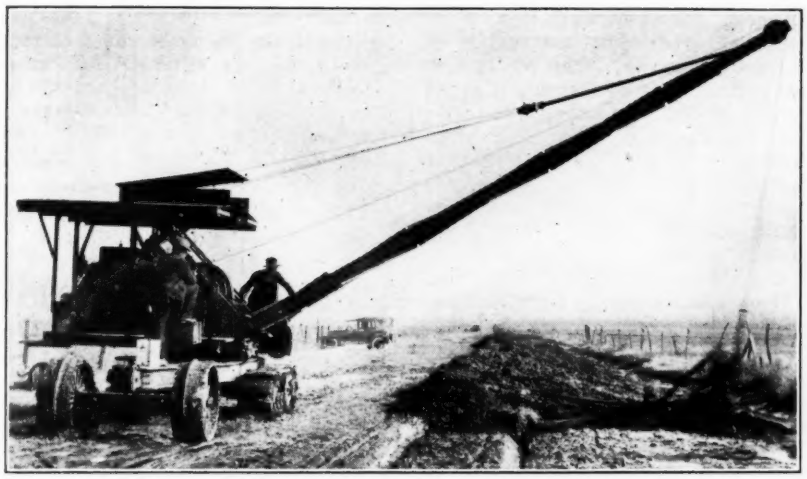
At first thought it might appear that the compensation of a contractor could be saved by an organization operated by the Highway Department, but analysis makes it evident that the item of compensation of a contractor, if conservative, would closely correspond to the operating expenses of an organization owned by the Highway Department, and, while it should not be the case, I am afraid in actual practice it would be hard to get supervision for a state contract in an organization working on salary that would exert the same effort in construction as would a contractor, under the Form "B" contract, where incentive in dollars and cents would be to keep the construction cost under the estimate. At the same time the estimate must be conservative in order to meet the competitive feature.

In addition to this objection to a state construction organization, there would be the enormous investment in equipment which could only be used on state highway work, whereas a contractor has for a field not only state highways within the state, but in other states, as well as municipal, railroad work, etc.

Gives Good Contractors of Small Means a Chance

One of the first advantages in this new form of contract is that it permits honest contractors of small means to show their ability on a larger scale than would be possible under the old form, under which a surety bond is required for the full amount of the contract, which many contractors of small means are unable to make. At the same time, the facilities of financing this Form "B" contract open a field for intelligent, honest bidders who would otherwise be unable to participate in a project of very great magnitude, except as sub-contractors, although their ability might be ample to handle the project. A striking example of this is a recently completed concrete paving project. The successful bidders could not have financed a project of this extent under the old form of contract, and yet they have had charge of the construction of more miles of concrete pavement within the state than any other contractor.

The result has been that 5½ miles of



P & H Excavator-Crane Excavating Road Ditch and Grading Road

Road Builders' Combination Machine for Excavating, Grading, Backfilling and Material Handling

The P & H Excavator-Crane is capable of performing the four general functions of Excavating, Grading, Backfilling and Material Handling. The four major uses of this equipment by road builders are as follows:

Grading Roads. Where roadbeds are low and need "shouldering up," or where fill must be made through water-logged and swampy land, the P & H Excavator-Crane will pull in and heap up the ground much faster and cheaper than will teams and graders.

Making Cuts. The P & H will make cuts in roads at the rate of 300 to 500 yards per day. The average cost seldom exceeds $20 for a day's operation. When the excavated material is loaded in wagons, the capacity is reduced only about 10 per cent. For constructing drainage ditches the P & H is run alongside or center of the completed road, excavating the ditches to the required depth and wasting the dirt on the slope of the roadbed or beyond the ditch. On this operation the machine cost is rarely over 8 cents per yard, even when handling wet earth where it is often impossible to work teams.

Excavating Gravel. Capacity (approximate) 300 to 500 yards per day of gravel from the bank into trucks and wagons. The hauling equipment, working with a P & H, is never in the excavated hole as it is with steam shovel or trap loading. The P & H Excavator-Crane has a full circle, non-obstructed swing with an operating radius of 30 feet.

A Complete Portable Locomotive Crane. Equipped with a hook. magnet or other grappling device, the P & H is a complete portable locomotive crane with a lifting capacity of 3,500 pounds at 30-ft. radius. Great for cleaning up a yard, placing pipe in trenches, pulling piles, moving the bulky stuff, loading and unloading cars.

Write today for Bulletin 5-X to

Pawling & Harnischfeger Co.

Est. 1884

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L. C. Smith Building, Seattle, Wash.

"You see them wherever you go, and they go wherever you see them"

P&H Excavator-Crane No. 205

18-ft. concrete pavement were laid in 3¼ months at a 15 per cent. net saving on the contract as awarded. The contractors not only earned their compensation as set forth in their bid, but an additional 50 per cent., the maximum amount permissible. The advertisement for the letting of this contract, as is our custom, called for bids under both forms of contract. The successful bid was on Form "B," and was 24 per cent. less than the next lowest bid, which was on the old form of contract, and it therefore resulted in an actual net saving of practically 30 per cent. under the Form "B" as against the standard form of contract.

Project 1-A/F-2, concrete pavement, is showing a saving of 11.3 per cent. on first estimate.

F. A. Project No. 162, a grading job, shows a saving of 13.2 per cent., and the work has been under way for more than 3 months.

Results Attained

The contracts now under way in Georgia under the Form "B" amount to over $1,500,000, and a saving of a little over $20,000 has been effected in bond premiums alone, as a minimum bond is required under this form of contract.

The supervision that is required under the Form "B" contract by the owner requires a very high-class man, preferably one with experience as an inspector on the old form contract, and also experience as a contractor or superintendent for a contractor. His duties are to watch for violations of the contract and to catch the leakages on the job. The former duty should be performed subconsciously, but most of his thoughts should be centered on methods to reduce the cost. The cost sheet tells him a very true story, and should be kept up to date, so that he can see at a glance where he should put most of his attention.

I will conclude by stating that, in my judgment, this form of contract requires a more intelligent insight into construction details and a more thorough knowledge and analysis of costs by the engineer than the old form.

This address by Mr. Neel was delivered at the sixth annual meeting of the American Association of State Highway Officials.

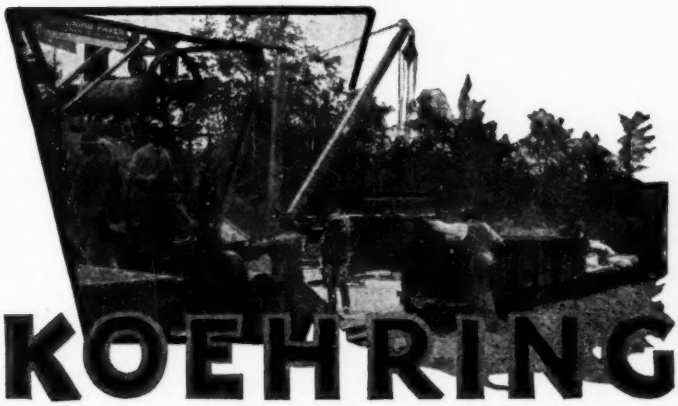
NEW SNOW LOADER HAS SUCCESSFUL TRIAL ON CHICAGO STREETS

A gang of 50 or 60 men for removing snow from the streets of Chicago was replaced by four men and the new snow loader manufactured by Barber-Greene Co., Aurora, Ill., in its initial test following the first heavy snow of the winter. Besides successfully replacing so many men, the machine was able to load so quickly that a great reduction was possible in the number of trucks required. Four trucks only, each being loaded in an average of 5 minutes, were needed where 12 were required before, when most of their time was spent in waiting during loading.

No change had to be made in the usual scheme followed in removing the snow by hand. Snow plows attached to trucks placed the snow in long windrows in the gutters. In place of swarming gangs of men shoveling into high trucks, came the loader, filling the trucks to overflowing so quickly that side boards for the trucks to carry a greater load became imperative.

The machine is mounted on crawlers to gain the best traction. It is powered by a Buda 4-cylinder truck-type gasoline engine. A 2-armed apron scoops up and throws the snow onto a wide cleated belt, which carries it up to discharge into waiting motor trucks. This apron plow is ad-

NEW BARBER-GREENE SNOW LOADER WORKING ON CHICAGO STREETS.



KOEHRING

The Paver of Low Mixing Cost

EVERY second of time saving means money saving—profit making on a paving job. The paver that is lowest in cubic yard mixing cost is the cheapest mixer. Any other is costly.

Extra Yardage Built in

Koehring mixers *are designed* to give the lowest mixing cost. Centralized control—the many automatic actions found only on Koehrings enable the operator to maintain that day after day speed of operation which means a big season's extra yardage.

Heavy Duty Construction

Heavy duty construction is but another term for dependability—and dependability pays a big extra profit in trouble-free continuous operation—which means lowest mixing cost.

Koehring mixed concrete is dominant strength concrete.

Write for Koehring Paver Details

Koehring low mix cost—dependability—can't be wished nto a mixer. It must be built in. It is built into Koehriings. Investigate. Write for details of Koehring pavers.

Koehring Machine Co.
MILWAUKEE, WISCONSIN.

KOEHRING SIZES
in cubic feet mixed concrete

Pavers: 10, 14, 21 and 28 cubic feet mixed concrete. Standard wet batch rating. Boom and bucket and spout distribution, steam and gasoline. Loading derrick, multiplane traction.

Construction Mixers. Sizes: 4, 7, 10, 14, 21, 28 cubic feet mixed concrete.

justable. It is possible to scrape the surface clean or leave enough space to pass over any obstruction. Adjustment is made by the operator from his platform on the loader. Skirt boards 12 ins. deep keep the largest lumps on the belt and give it an effective carrying width of 36 ins. The belt is positive drive, being fitted with roller chain on each edge.

Chicago city officials put the loader to work the day after Christmas to remove the snow on Michigan boulevard. After working the downtown length of the boulevard, the machine worked across into the loop district. It ran for 30 hours without a pause, being operated by three shifts of 8 hours each. A minor repair was made and the machine continued. One of the things that recommended it most highly to the officials in charge was the fact that it would work just as hard between midnight and morning as at any other time; this is the time when men are least efficient, if they will work at all.

This is the first machine of its kind to be put on the market and it is covered fully by patents. Mr. Barber developed the idea late in the summer of 1920. It had its first try-outs in coal and ashes. Chicago expects to use the machine for ash and gravel loading during the summer.

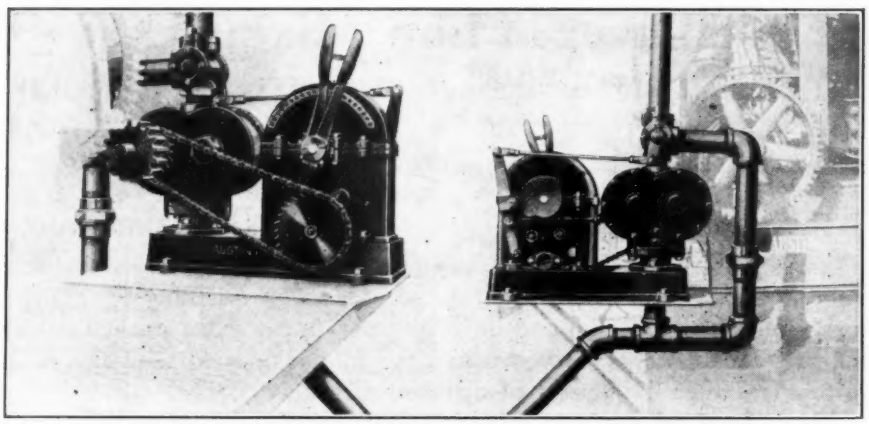
A NEW AUTOMATIC METER-PUMP

Considerable interest is being manifested in a detailed report just published on a series of tests recently undergone by a new automatic meter-pump designed by an engineer connected with the Austin Machinery Corporation of Chicago. Formal announcement at an early date is promised.

This novel device, as its name implies, measures the water discharged into concrete mixers and paving machines. It insures a uniformly accurate quantity for each batch. It is fast. "A better batch faster" sums up the advantages claimed for it.

Simplicity is its main characteristic—it is surprisingly simple in both construction and operation. Setting a pin for the exact quantity of water required takes but a moment, and then no more attention is required until the job is done, except, possibly, to move the pin a hole or two to offset any variations likely to occur in the moisture of the ingredients.

The device consists of a pump, a valve, a timer, and a few pipes and fittings. The pump is driven from the mixer shaft. It works continuously. It can lift water approximately 12 ft. from dead water to pump, or take water from hydrant. The two-way valve is "opened" and "closed" by means of a cam on the timer controlled by the starting lever. When the valve is "open" the water is discharged into the mixer; when "closed," it circulates through a return loop in the pipe.



VIEWS OF THE NEW AUSTIN AUTOMATIC METER-PUMP.

The operator "opens" the valve by throwing the starting lever over to the timing pin. Then he forgets it until the next batch is ready for water. The valve "closes" itself automatically at the precise moment the pre-determined quantity of water has been discharged.

How much or how little water is required makes no difference to this device, as it has a range of about 250 per cent. between minimum and maximum discharge. Throwing the starting lever is the work of an instant. It does not interfere in any way with the operator's regu-

lar duties. The total weight does not exceed 200 lbs.

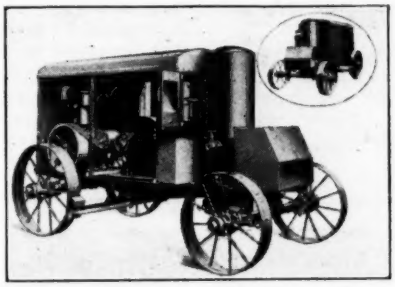
The report states that the tests to which this device was subjected were not confined to the usual factory routine, but extended over a period of time in actual practice.

A NEW ELECTRICALLY DRIVEN PORTABLE AIR COMPRESSOR

Contractors using compressed air are already familiar with the Ingersoll-Rand gasoline engine driven "Imperial" portable compressors. These units are driven by tractor type gasoline motors and built in three sizes, with capacities of 45, 118 and 210 cu. ft. per minute.

To meet the ever-increasing needs of the contractors, street railways and public service companies, having available electric current, an electric motor driven "Imperial" has been added to this portable family. This unit is of 118 cu. ft. capacity and weighs approximately 4,450 lbs., depending upon the weight of the motor. As in the corresponding gasoline motor driven compressor, this electric unit is an all-steel outfit from its sheet canopy to the broad tired steel wheels. Light steel doors completely house the entire unit protecting it from the weather. These doors are easily removed to allow free access to all parts.

Suitable intake unloader is provided, assuring efficient regulation. Either alternating or direct current motor can be

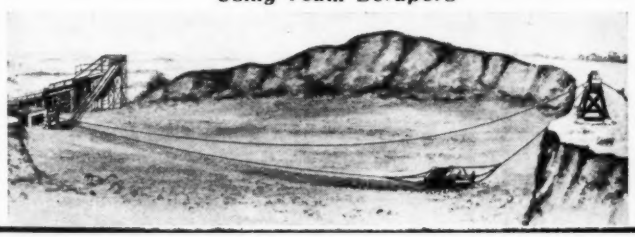


THE IMPERIAL ELECTRIC DRIVEN PORTABLE AIR COMPRESSOR.

furnished. In any case, the motor control is in accordance with standard practice and specifications covering the type of motor used. Additional equipment includes air receiver, safety valve, drain valves, pressure gage and service valves, to which air hose lines may be connected.

A Labor-Saver for Small Gravel Pits

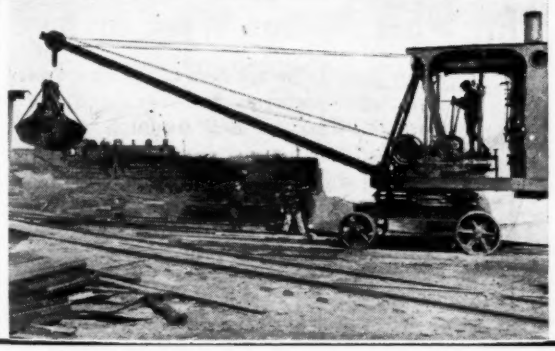
One Man with a Sauerman Bottomless Power Scraper Does the Work of a Large Gang of Men Using Team Scrapers



With a double-drum hoist and a Sauerman Bottomless Power Scraper, one man can excavate and move from 100 to 1000 cubic yards of sand and gravel per day, the handling capacity varying according to the size scraper used and the distance the material has to be conveyed.

For photographs and diagrams of actual installations, write for Pamphlet No. 10.

SAUERMAN BROS.
1142 Monadnock Bldg.
CHICAGO



Full Revolving Self-Propelling

Locomotive Cranes

Mounted on Traction Road Wheels.
Equipped with 30-ft. Booms and ¾-yard Clamshell Buckets.

ALL BRAND NEW

Road Builders' Equipment **Asphalt Plants**
Revolving Traction Shovels **Road Rollers**

F. MAYER, 53 W. Jackson Blvd. CHICAGO, ILL.

Contractors' Equipment of All Kinds.

BLASTING ROCK IN BUILT-UP SECTIONS

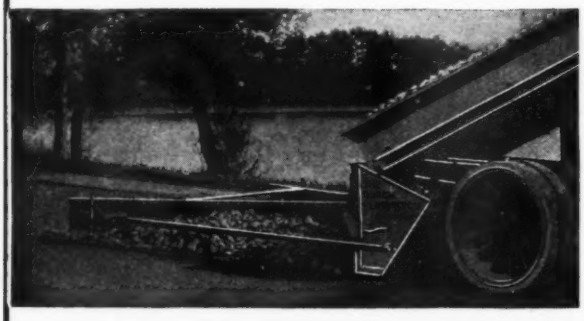
By James Veness, Connecticut.

I find that many contractors hesitate to use dynamite for blasting in rock if other buildings are near-by. It is my opinion, based on long experience, that damage to buildings, and especially windows, is almost always caused by loading bore holes too heavily or by trying to break up too great an area of rock in a single blast.

Of course, the temptation is strong to put down a number of holes, connect up the charges in series, and fire simultaneously, to get the cumulative effect resulting from that method of loading. Of course, that is the economical way, the time-saving way, the way that should be adopted when the excavation is a safe distance away from other structures, but otherwise single-hole shots and small charges should be the rule.

At the Kent School, New Milford, Conn., the cellar was to be 36 ft. x 26 ft. and 7 ft. deep. Rock extended 2 ft. above the ground—that is, 9 ft. of rock excavation. A three-story glass-front building stood within 30 ft.

Several contractors refused the job be-



Reduces Labor to Minimum

The initial cost of a Burch Stone Spreader is made up in only a few days through labor economy. It enables one man, at a single operation, to dump and spread stone simultaneously.

BURCH STONE SPREADER

One man and a Burch Spreader will accomplish as much work as ten men by the old method. Can be attached to any truck in a couple minutes' time. Easily and quickly adjusted to any depth, width or pitch of road desired. ***Write for Catalog.***

The Burch Plow Works Co.

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LITTLEFORD

Tar and Asphalt Heaters

No. 69. Tar and Asphalt Heater

Favored by municipalities and leading contractors everywhere for

MAINTAINING and BUILDING ROADS and PAVEMENTS

The No. 69 Heater illustrated is exceptionally strong. It is very compact and convenient to handle. Made in several sizes and will burn coal, wood or oil.

Circulars and Prices on Request.

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PORTABLE MACHINERY CO., PASSAIC N.J.

What Do You Want to Buy?

If you want to be relieved of the annoyance of extensive correspondence and calls from salesmen who do not understand your needs, just write a brief letter to us stating your requirements and we shall immediately place you in touch with the manufacturer best qualified to serve you.

Municipal and County Engineering

538 S. Clark St. Chicago, Ill.

cause of the risks. By employing the following simple method, I got away with it without doing a cent's worth of damage: Bore holes were drilled 18 ins. deep and loaded with 1½ lbs. of 40 per cent. ammonia dynamite. Charges were covered with four or five railroad ties chained together and fired a single shot at a time. Only 70 lbs. of dynamite were used on the job, which was completed by three men in three weeks.

RESURFACING WORN BRICK PAVEMENTS.

The Asphalt Sales Department of The Texas Company has just issued a new and highly instructive booklet on how to save worn brick pavements with Texaco asphalt. The literature loses no time in getting down to "brass tacks," and states in a plain, concise, non-technical manner the exact method of procedure in using Texaco asphalt to surface worn brick pavements. Aside from giving the steps in construction in words, there are also diagrams which illustrate the work thoroughly. Supplementing the literature and the diagrams are photographs from which one can gain a comprehensive and thorough knowledge of the exact steps in this construction. Copies of this booklet may be obtained by a request directed to this magazine, or to The Texas Company, Asphalt Sales Department, 17 Battery Place, New York City.

Contracts Awarded

ROADS AND STREETS.

Ala., Guntersville—W. G. Taylor Construction Co., Wilsonville, Ala., awarded contract to grade and drain 18 miles Guntersville and Boaz Rd., $150,000 available.

Ariz., Globe—McPeak, Dillon & Bruckman, 620 Security Bldg., Los Angeles, awarded contract for paving Broad St., 1.1 miles, with one course conc., at $163,943.

Ariz., Tucson—R. Mackay & Co., 312 E. 4th St., awarded contract for bldg. 6-mile Sec. 2, Arivaca Rd., at $57,327.

Cal., Fresno—Federal Constr. Co., Fresno, awarded contract for constructing Sec. A, Route 8, and parts of Secs. B, Route 8 and A, Route 7, county highway; 4.5103 miles, at $110,240; also contract for paving Secs. A & B, Route 26; 9.11 miles, with asph. conc., at $218,078.

Cal., Los Angeles—Wm. Liddington, 420 E. 60th St., awarded contract for impvt. of first alley west of Kingsley Drive betw. 1st alley so. of Temple St. and First St., at $4,174; Rogers Bros. Company, 350 Merrick St., awarded contr. for paving Lark Ellen Ave., in Rd. Impvt. Dis. 168, with oil macad. on disintegrated granite base; also constructing metal pipe and conc. culverts, at $57,360.

Cal., Los Angeles—W. D. McCray, 424 Am. Bk. Bldg., awarded contr. for impvt. of Gleason Ave. betw. Indiana and Lorena Sts., at $22,936; Wm. L. Riley, 210 S. Fremont Ave., awarded contr. for impvt. of Berkeley Ave. betw. Lemoyne St. and Lakeshore Ave., at $1,941; Wm. Liddington, 420 E. 60th St. awarded contract for impvt. of 1st alley so. of 7th St., no. of Carondelet St. and another alley, at $4,767; Lagana Land Co., Consolidated Realty Bldg., awarded contract by city for paving Cudahy Ave., involving 560 cu. yds. excav., 4.316 ft. shaping roadbeds and 10,625 sq. ft. 4-in. Willite pavement; Janss Investment Co., Metropolitan Bldg., will grade and oil streets, constr. cem. curbs and walks, lay gas, water and sewer mains in 60-acre subdiv., on Lus Felix Rd. and Vermont Ave., by Day Labor under supervision of W. H. Tuck, Engr. Est. cost abt. $10,000.

Ga., Chatsworth—Hagedorn Constr. Co., Commerce, awarded contract for bldg. 6.7 miles soil surface road betw. here and Whitfield-Murray County line, at about $75,000.

Ill., Glen Ellyn—E. M. Scheflon, Elgin, awarded

The „Minerva" Fountain Ruling Pen

Will do a whole day's work with one filling

You can concentrate on your work—use any kind of ink—will not leak or blot.

Guaranteed to operate satisfactorily.

Price Only $5.00, Postpaid. **ORDER TODAY!**

KOLESCH & COMPANY

138 Fulton Street **NEW-YORK**

contr. for paving Forest and Penn. Aves., Park Blvd. and Oak St., rein. conc., at $67,609.

Ia., Carroll—Peterson, Shirley & Gunther, 1217 W. O. W. Bldg., Omaha, awarded contract for impvt. of 19 miles Coon Rapids-Dedham-Templeton-Manning Rd., 24 ft. wide, at $125,266.

Ia., Kimberly—Warren Constr. Co., Portland, Ore., awarded contr. for 9,350 sq. yds. Warrenite-B pavement on 4-in. crushed rock fdn., and 13,200 sq. yds. Warrenite-B pavement on 3-in. crushed rock fdn.

Ill., Lockport—R. F. Conway Co., Chicago, Ill., awarded contract for asph.-conc. pavement on Hamilton St., at $215,901.90.

Ia., Sioux City—C. F. Lytle Constr. Co., Lytle Blk., Sioux City, awarded contract for grading and paving 14 miles of rd. betw. Sioux City and Moville; also 3.73 mi. betw. Sioux City and Sargent's Bluff. Contr. includes 66,067 cu. yds. grading at $1.25 per yd.; 188,236 sq. yds. paving at $3.69 per yd. reinf. conc. paving, 8 in. thick, 20 ft. wide, and gravel furnished f. o. b. pit near Correctionville, Ia.

Ia., Webster City—C. A. Barnes, 323 5th St., Des Moines, awarded contract for grading 11 miles Grant Hwy. east of here, 24 ft. wide, at about $35,000.

Kans., Columbus—W. C. Judsch, Sapulpa, Okla., awarded contract for grading and graveling 13 miles Oswego Rd., 18 ft. wide, at $187,504.

Ky., Frankfort—Geo. M. Eady Co., Louisville, awarded contr. for construction of 4-mile Kentucky rock asph. Louisville-Bardstown Rd., Nelson Co., at $99,752.

La., New Orleans—Peterman and Loustalot, Franklin, awarded contract for bldg. 10.43 miles Hammond-Baton Rouge Hwy., gravel, Livingston Parish, at $125,714; Craven & Lang, 1015 Hibernia Bk. Bldg., awarded contract for paving Audubon St., Zimple St. to St. Charles Ave., Bitulithic, at $28,623; bldg. subsurface drains to A. P. Boh, 4148 Banks St., at $49,106.

Mich., Crystal Falls—Smith-Sparks-Burridge Co., Crystal Falls, awarded contract for Co. Rd. 73-1-B, Stamnaugh Twp., at $32,703; Class A gravel, 16 ft. wide.

Mich., Lansing—Oakland County Road Commrs., Pontiac, awarded contr. for impvt. of 1.366 miles State Trunk Rd., involving 72.1 stations fine grading and 16,029 sq. yds. bitum. conc. wearing course, at $39,658; T. H. Duvall, McBain, awarded contract for grading, draining and surfacing 3.575 miles State Trunk Line Rd., 20-1, 6 ft. wide, Osceola County, at $33,313.

Mich., Lansing—Jenks & Dewart, 1514 Military Ave., Pt. Huron, awarded contract for grading and surfacing with conc. 16.595 mi. F. A. Proj. 38, St. Clair Co., Sects. A, B and C, at total cost of $635,231.

Minn., Grand Rapids—E. W. Coons Co., 230 Center St., Hibbing, awarded contract for bldg. 7 mile Job 2004, State Rd. 9, at about $150,000.

Minn., Luverne—Hanlon and Okes, 338 Lumber Exch. Bldg., Minneapolis, awarded contract for 150,000 sq. yds. conc. paevment on 6-in. base, at $3.08 per sq. yd.

Mont., Big Timber—A. Carlson, Columbus, awarded contract for 3 mi. graveling, Proj. 134, at $35,080.

Minn., Mantorville—Cameron, Joyce & Co., Keokuk, Ia., awarded contract for bldg. F. A. Proj. 200, at abt. $50,000.

Mont., Butte—A. Carlson, Columbus, awarded contract, subject to approval of Federal Bureau of Public Roads and county commissioners, for Proj. 134, Sweet Grass Co., at $35,080.

N. J., Middlesex—Standard Bitulithic Co., New York City, awarded contract for 12,087 sq. yds. Warrenite-Bithulithic pavement on 6-in. conc. fdn.

N. M., Sante Fe—Dan La Roe, Palestine, Tex., awarded contract for F. A. Proj. 22, Guadalupe Co., at $132,400, exclusive of 10 per cent. for engrg. and contingencies, also contr. on F. A. Proj. 28, Grant Co., at $214,090, exclu. of 10 per cent. for engrg. and contingencies; J. V. Stryker Constr. Co., Denver, Colo., awarded contract for F. A. Proj. 23, De Baca Co., at $33,672, exclusive of 10 per cent. for engrg. and contingencies, and contr. for F. A. Proj. 43, Torrance Co., at $19,853, exclusive of 10 per cent. for engrg.

N. C., Raleigh—Porter & Boyd, Realty Bldg., Charlotte, awarded contr. for impvt. of 8.73 miles road from Hornet Creek to city limits of Whitakers, 18 ft. wide, F. A. Proj. 73, Nash Co., at $143,375.

N. C., Greensboro—R. G. Lassiter & Co., 327-33 Monticello St., Arcade Bldg., Norfolk, Va., awarded contract for paving Woodlawn St., conc. or other hard surf. material, at cost to exceed $100,000.

N. C., Raleigh—State Hwy. Comm. let contract for impvt. of 4.54 mi. rd., Forsyth Co. line to Guilford Co. line, 18 ft. wide, Davidson Co. to Helig & Sherill, P. O. Box 9, Winston-Salem, at $56,587; contr. for impvt. of 7.63 mi. rd. betw. Wilson-Wayne Co. line and Wiggins Mill, 18 ft. wide, and 6.25 mi. rd. from Wilson Twp. line to Wilson-Nash Co. line, to Bd. Rd. Commrs., Wilson Co., Wilson, at $30,826, and $25,984, respectively.

Ohio, Dayton—C. Hoolihan, So. Main St., awarded contract for paving 1.7 miles Troy Pike from Vandalia southward 20 ft. wide, involving 20,000 sq. yds. conc. on conc. base, at $90,881.

Okla., Antlers—Jno. W. Rocks, McAlester, Okla., awarded contract to construct 8 mile gravel road, at $62,186.

Okla., Idabel—S. B. McCartney, Valiant, Okla., awarded contract to construct 12 miles of road, at $152,139.

Okla., Newkirk—Ben Flynn, Newkirk, awarded contract for paving 1⅛ miles conc. road, at $62,617; M. A. Swatek & Co., Oklahoma City, contract for .79 miles brick road, at $61,613.

Okla., Oklahoma City—Western Paving Co. awarded contracts for paving various streets here at $85,000.

Okla., Wilburton—J. S. Terry, Poteau, Okla., awarded contract to construct 2¾ miles gravel road at $42,350.

R. I., Providence—Lane Constr. Co., 37 Colony St., Meriden, Conn., awarded contract for constructing section of Danielson Pike for distance of 5 miles bitum., in town of Scituate, at $175,520.

S. C., Columbia—J. L. Carroll Co., Anderson, awarded contract for bldg. 12.722 miles Columbia-Savannah Hwy. with necessary bridges betw. city limits of Orangeburg and sta. 1187 near Bamberg Co. line, at $61,189.

S. C., Walhalla—Elliott & Sons, Union, awarded contract for topsoiling 8 miles Seneca-Walhalla Rd., at about $45,000.

S. D., Tyndall—Peterson, Shirley & Gunther, Omaha, Neb., awarded contr. for grading and draining 12.942 miles Tyndall-Lake Andes Rd., 36 ft. wide, F. A. Proj. 38, Bone Homme Co., at $48,811.

Tenn., Knoxville—Murray Constr. Co. awarded contract to pave Thompson Place, White Ave., Patterson, Payne and Central Sts.—Scott Ave. to Southern Ry., etc., at $126,000.

Tex., Center—Smith Bros., Crockett, Tex., awarded contract to construct 35.5 miles Hwy. 22—San Augustine Co. line to La. State line, at $319,490.

Tex., Dallas—Uvalde Paving Co. awarded contract to pave Thomas St., at $76,383; Texas Bitulithic Co. contract to pave Dickason St., at $9,939.

Tex., Georgetown—W. Dozier, Taylor, Tex., awarded contract to construct 60 miles hard-surfaced road, $900,000 available.

Tex., Leavenworth—Contracts for grading, constructing culvts. and bridges, etc., on Sects. D. E and D, 12 miles of Fort-to-Fort Hwy. betw. Tonganowie and Wyandotte Co. line, awarded as follows: brdgs. along the 12 miles of highway awarded to D. Munroe, Kansas City, Kans., at $73,417; culvts. and small brdgs. on Sec. F, Proj. 13, to F. M. Clark, Savannah, Mo., at $38,476; grading on Sec. F, to Gaines Bros., Fairland, Okla., at $96,079; List & Hallett, Kansas City, Mo., grading and culvert work on Sec. F, at $128,977.

Tex., Nacogdoches—Following road contracts awarded: H. F. Bland, St. Augustine, Tex., 9.73 miles Highway 35, at $76,838, and 23.17 miles Hwy. 21, at $712,319; also contract for 19.58 miles Garrison Rd., from Nacogdoches to Shelby Co., at $138,607.

Tex., Orange—Houston Constr. Co., McKinney Ave., Houston, awarded contract for grading surfacing and draining 4.98 miles Hwy. No. 3, Orange-Beaumont Rd., at $245,598, including 10 per cent. for engrg. and contingencies.

Tex., Sinton—San Patricio Co. Commrs. will construct 12.5 miles Corpus Christi Rd. in District No. 5; let contract to Defined Road Dist. No. 5, care of Commrs. Benson, Caldwell and Vogel, at $188,148, including materials; also contract to same Dist. for 15.06 miles Hwy. No. 9, at $162,138.

Wash., Seattle—F. McLellan, 1720 16th Ave., awarded contract for paving, grading and curbing Seattle Blvd. et al., involving 10,270 sq. yds. brick blk. on 6-in. base, 10,760 sq. yds. 8-in. conc., 3,250 lin. ft. armor conc. curbing, 6,500 lin. ft. special conc. curbing and 65,000 cu. yds. earth excav., at $176,888.

Wis., Elkhorn—McGucken Constr. Co., Milwau-

kee, awarded contract for Town Line Rd., F. A. Proj. 115, at $153,944; 18-ft. conc. surface.

SEWERAGE AND SEWAGE TREATMENT.

Cal., Calexico—H. H. Peterson, local, awarded contract for constr. of sewers involving 14,417 ft. 6-in. vit. pipe, at $1.26 ft., 14 manholes at $90 each, and 15 flush tanks manholes at $100 each, etc. Total, $16,837.

Cal., Los Angeles—Jno. Balch, 696 12th St., San Pedro, awarded contract for constructing cem. pipe sewer in Ocean Ave. and other streets, at $54,811; Jno. Sutalo, 476 Camulos St., awarded contract for constructing cem. pipe sewer in Ravenna Ave. betw. J. & K. Sts., at $2,819; S. Zarubica & P. S. Tomich, 3006 Sixth Ave., awarded contr. for constr. of cem. pipe sewer in Harvard Blvd. betw. Temple St. and Oakwood Ave., at $1,675; Andrew Jaynich, 303 LeRoy St., award. contr. for cem. pipe sewer in portion of Farmer St. and in alley, at $1,000; Andrew Dalmatin, 818 E. 40th St., awarded contr. for constructing vitr .pipe sewer in Amethyst St., at $4,500.

Cal., Los Angeles—Jno. P. Kennedy, P. O. Box 571, Long Beach, awarded contract for constr. of cem. pipe sewer in 84th St. and Vermont Ave., sewer dist., at $45,000.

Ct., Bridgeport—Sanitation Co., 50 Church St., New York City, award. contract for furnishing and installing machy. and equipt. in sewage disp. plant on Harborview Ave., Black Rock Sta., at $19,500.

Ill., E. Moline—National Construction Co., Davenport, awarded contract for bldg. big storm sewer here, at $236,146.

Ia., Bellevue—Hammen-Kruse, Spencer, awarded contract to construct 5 miles of sewers, at $67,-305.

Ky., Covington—Comn. Pub. Wks. let contracts for bldg. 6-18 in. sewers in 27th St. and Decoursey Ave. to E. J. McKenna, Covington, at $22,869 and $7,276, respectively; Madison Ave. to W. Metzel, local, at $6,834.

Mass., Chicopee—D. H. Young, Willimansett, awarded contract to complete Willimansett sewer in McKinstry Ave. and Meadow Rd., segmental block, at about $165,000.

Mass., Northampton—D. A. Sullivan, Paradise Rd., awarded contr. for bldg. 1 sty. brick and conc. pumping station, 550-ft. 10-in. vitr. pipe line and 285-ft. 10-in. cast iron pipe line with manholes, covers, etc., at about $15,000.

Mich., Detroit—City let contract to Detroit Drainage Constr. Co., Penobscot Bldg., for constr. of Lat. Sewer 3264 betw. Fairview, Engel, Marsh and Edlie Aves., at $14,000; 3300, at $11,920; 3395, at $42,-358; 3396, at $10,240; R. D. Baker, 1454 Penobscot Bldg., 3389, at $4,998.

Mich., Detroit—City let contract for bldg. Third Ave. sewer, Sects. 4 and 5, to J. A. Mercier, 206 Hammond Bldg., at $231,975 and $127,572, respectively; contract to Western Constr. Co., 1208 Ford Bldg., for labor and material for bldg. lateral sewers 3300 and 3314, at $35,361 and $29,990, respectively; Lennane and McIlvenna, 1206 Book Bldg., 3377, 3385 and 3386, at $11,000, $5,750 and $3,750, respectively.

Mich. Detroit—City let contr. for bldg. Six Mile Rd. Sewer, Sec. 5, and Sec. 6, to J. Porath, 20 McGraw Bldg., at $418,000 and $354,114, respectively; Sec. 7, to W. Blanck & Co., 827 Ford Bldg., at $239,117.

Mich., Detroit—Dept. Pub. Wks. City Hall, will construct Gratiot Ave. Sewer from point 1100 ft. northeast of Glenfield Ave. to Joann Rd. Abt. $425,000. Work will be done by Day Labor.

Mich., River Rouge—Boston & Errington Cem. Constr. Co., 108 Buhl Blk., Detroit, awarded contr. for bldg. rein. conc. sump for sewerage system, involving 1,450 cu. yds. excav., 280 cu. yds. rein. conc. and 10½ tons steel, at about $20,000.

Mo., Cameron—Johnson and Kobett, Cameron, awarded contract for bldg. clay sewers in various streets, involving 5,840 ft 8-in. vitr. pipe, etc., at $13,467.

Mo., Kansas City—Kinler Constr. Co., 3426 Mich. Ave., awarded contract to construct sewer at $16,185.

N. J., Patterson—Arnold-More Co., 45 Clinton St., Newark, awarded contr. for earth excav. and refilling in trench for 16-in. cast iron pipe, for portion of Sec. 21, No. Prospect St., branch sewer at $12,464.

N. Y., Syracuse—J. Young, Bastable Blk., awarded contr. for bldg. sewer in Hiawatha St., at $258,-551.

N. C., Maiden—Votd, Higgins & Goforth, Charlotte, awarded contr. to constr. sewer and water systems, at $115,000. Work includes 25,000 ft. 6-in. to 10-in. vitr. pipe, 20,000 ft. 1½ to 6-in. water mains, 28 fire hydrants, 3 sewage disp. plants, one 100,000-gal. stand. pipe, 2 deep wells, pumping equipt., etc.

Ohio, Cleveland (Cleveland P. O.)—T. Marro, Illuminating Bldg., Cleveland, awarded contract for bldg. sewer and culvert in Terrace Rd.; Taylor Rd. to Hastings Ave., at $16,501.

Okla., Miami—J. S. Shoe, City Hall, awarded contr. for bldg. out-fall sewer and sewage disp. plant, involving 1,200 ft. 4 to 24-in. vitr. pipe, 4,750 cu. yds. earth and 650 cu. yds. rock trenching, etc. Abt. $141,000.

Pa., Phila.—Additional branch sewer constr. contracts let: Est. of David McMahon, Mayland St., Musgrave to abt 150 ft. N. E., at $4,500; J. Jos. McHugh, Broad St., 69th Ave. to abt 210 ft. No. at $2,300; Carmelo Ricciardi, Watts St., Shunk St., northward, at $5,000; McCool Constr. Co., in Fillmore St., Peiper to Oakland St., at $10,200; Edw. A. Mullen, 65th St.; Haverford Ave. to Lansdowne Ave., at $30,000; Carmelo Ricciardi, sewer in Dufor St.; 4th to 5th St., at $6,500.

Pa., Phila.—J. J. McHugh, 1430 S. Penn. Sq., awarded contr. for bldg. brick sewer in 59th St., Springfield to Beaumont Sts., at abt. $20,000.

Pa., Wilkes-Barre—Goeringer Constr. Co. awarded contr. by Hanover Twp. Commrs. to complete sewers in Twp., at $210,000.

Texas, Dallas—City let contract for 25,000 cu. yds. earth trenching and laying 2 miles vitr. and tile pipe sewers in connection with san. sewerage system in Parkview Addn., to Klein Bros. Junius and Walton Sts., at $38,773; pipe to Blackmer & Post Pipe Co., Dallas, at $18,861.

Tex., Ft. Worth—Wills & Tyson Constr. Co., awarded contr. for construction of two storm sewers on Evans Ave., at about $5,000; Dwight P. Robertson & Co., Wall St., New York, awarded contr. for constr. of sewage disp. plant at estimated cost of $800,000. Constr. work will probably not begin until July 1.

Tex., Wichita Falls—C. H. Foley, awarded contr. to construct storm sewers; vitr. clay pipe; 55 inlets; 5 manholes; 62 yds. conc.; 1320 sq. yds. paving; replacement; 160 ft. piling, etc., at $187,917.

Utah, Salt Lake City—R. L. Campbell, Salt Lake City, awarded contr. for bldg. sewers in 5th St., so to Los Angeles & S. L. R. R. tracks and in 8th St. west to Redwood Rd., etc., at abt $200,168.

Wash., Seattle—Hansen & Hauge, Green Bldg., awarded contr. for bldg. sewers and grading Juneau St. et al., involving 13,000 cu. yds. earthwork, 1,450 lin. ft. 8-in. clay pipe, 73 6-in wyes, at $32,354.

Wis., Beaver Dam—Brogan & Burns, E. Main St., Green Bay, awarded contr. for excavating and laying san. and storm sewers in Chatham and Main Sts., involving 2,100 ft. 6012 in. vitr. pipe, at about $22,000.

Wis., Fond du Lac—R. Bernett, 389 4th St., awarded contr. for furnishing material, excavating and laying 1.1-mile san. and storm sewers in Brooke, Russel, Butler, Hickory, Walnut and W. Sibley Sts., at abt. $30,000.

Wash., Seattle—W. A. Kupoff, awarded contr. for sewers in N. 80th St., clay pipe, at $2,677, for sewers and watermains in Temple Place, clay pipe, at $4,323 and sewers, clay pipe, in N. 82nd St. at $3,652.

WATER SUPPLY & PURIFICATION.

Ark., Ft. Smith—Wm. Bros., awarded contract by Bd. of Impvts. W. W. Dist. No. 1, to constr. addns. and impvts., including boiler house, installing two 300 h. p. boilers; 3,500,000-gal. capy. addn. to filters, etc., at $200,000.

Cal., Hemet—Bent Bros. Constr. Co. Central Bldg., Los Angeles, have contr. to constr. two reinf. conc. pipe siphons, 435 ft. of 36-in. and 1,050 ft. 42-in. and to line with conc. two tunnels 100 and 256 ft. in length for Hemet Water Co. Work will be started Jan. 1. Cost will be abt. $20,000.

N. B., St. Johns—Canada Lock Joint Co., Prince William St., awarded contract for extension of water works system, involving 36-in. water main to Spruce Lake, at about $357,000.

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Barber Asphalt Co.
Bitoslag Paving Co.
The Barrett Co.
New Orleans Refining Co.
Pioneer Asphalt Co.
Sinclair Refining Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
Barber Asphalt Paving Co.
The Barrett Co.
Bitoslag Paving Co.
Sinclair Refining Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
Barber Asphalt Paving Co.
The Barrett Co.
Sinclair Refining Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.

Asphalt Plants.
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Railroad Plants.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Surface Heaters.
Barber Asphalt Paving Co.

Asphalt Tools.
Barber Asphalt Paving Co.
Warren Bros. Co.

Asphalt Tool Wagons.
Barber Asphalt Paving Co.

Auto Fire Apparatus.
Acme Motor Truck Co.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Co., The
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Back Fillers.
Austin Machinery Corporation.
Pawling and Harnischfeger.

Barber Brand Cold Repair Cement.
Barber Asphalt Paving Co.

Bar Cutters and Benders.
Koehring Machine Co.

Bars, Reinforcing.
Truscon Steel Co.

Bermudez Road Asphalt.
Barber Asphalt Paving Co.

Binders, Road.
Barber Asphalt Paving Co.
The Texas Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros. Co.

Bruces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.
Pan-American Bridge & Construction Co.

Buckets, Dredging, Excavating and Sewer.
Pawling and Harnischfeger.

Buckets, Dumping.
Pawling and Harnischfeger.

Buckets, Grab.
Mead-Morrison Mfg. Co.

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Pullers, Electric.
Mead-Morrison Mfg. Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement, Portland.
Portland Cement Association.

Cement Testing.
Kirschbraun, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Lakewood Engineering Co.
Smith Co., T. L. The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Concrete, Tanks.
Mensch, L. J.

Conduits.
Cannelton Sewer Pipe Co.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Conduits, Wood, Creosoted.
Republic Creosoting Co.

Consulting Engineers.
Alvord, John W.
Artingstall, Wm.
Brossmann, Chas.
Burd & Giffels.
City Wastes Disposal Co.
Dow & Smith.
Flood, Walter H., & Co.
Samuel A. Greeley.
Howard, J. W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Potter, Alexander.
Shields, W. S.
Van Trump, Isaac.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The
Barber Asphalt Paving Co.
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Lakewood Engineering Co.
Littleford Bros.
Smith Co., T. L. The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling and Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Crushed Stone.
Badger Crushed Granite Co.
Cleveland Stone Co., The

Culvert Molds.
Austin-Western Co., Ltd., The
Storms Mfg. Co.

Culvert Pipe, Cast Iron.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Curbing, Sandstone.
Cleveland Stone Co., The

Direct Oxidation Process.
Direct Oxidation Process Corp.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg. Co., W. E.

Dryers.
Cummer & Son Co., The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

Ia., Newton—A. Phelps Co., Knoxville, awarded contract for bldg. reservoir, pump house, 2 motor driven centrif. pumps, etc., at $44,825.

Kans., Liberal—American Well Works, 319 Reliance Bldg., Kansas City Mo., awarded contract for bldg. 2 centrif. pumps at $20,300.

Mass., Boston—Westinghouse Elec. & Mfg. Co., 10 High St., awarded contr. for furnishing and erecting 2 pumping plants and high pressure fire service at $174,469.

Mich., Hamtramck, (Detroit, P. O.)—J. A. McDace, 4036 Fairview Ave., Detroit, awarded contr. for furnishing and laying 3,870 ft. 6-in. cast iron watermains, etc., at about $25,000.

Mich., Oxford—Gangl Constr. Co., Akron, O., awarded contract for constr. of certain impvts. to water works system in Village, at $29,000.

Mich., River Rouge—L. C. Clancy, care of G. Jerome, 1331 Majestic Bldg., Detroit, award. contr. by Village for furnishing labor and materials for bldg. water main extens., involving 13,610 ft. 6-12 in. cast iron pipe, 20 fire hydrants, valves, connects., etc., at about $60,000; cost plus percentage basis.

Mich., Saginaw—T. A. Gillespie Co., 50 Church St., New York City, awarded contract for constr. steel pipe lines and river crossing at Holland Ave., at $147,290.

Minn., Duluth—National Cast Iron Pipe Co., awarded contract for furnishing cast iron pipe, at $23,700.

Neb., O'Neill—J. Danielson, Omaha, awarded contr. for laying water mains in various streets; cost plus percentage basis; furnishing 150,000-gal. tank and tower to Omaha Struct. Steel Co., 48th & Leavenworth Sts., Omaha, at abt. $20,500.

N. C., Maiden—Boyd, Higgins & Gogord, Inc., Charlotte, N. C., awarded contr. to constr. water and sewer system costing $115,000; 25,000 ft. 6 to 10-in. vitr. pipe, 20,000 ft. 1½ to 6 in. water mains, 28 fire hydrants, 3 sewage disp. plants, one 100,000-gal. standpipe, 2 deep wells, pumping equipt., etc.

Pa., Phila.—Bureau Water Supply, City Hall, let contracts for furnishing and installing piping system in Queens Lane pumping system, to Wood & Walcott, Inc., 832 43rd St., at $100,000; laying water pipe in recently improved streets, to A. A. Pastore, 5903 Woodland St., at $50,000.

Tex., Dallas—City will lay water mains, by Day Labor, in various streets and avenues. Est. cost about $70,000.

Wash., Seattle—Coluccio & Erickson, Ry. Exch. Bldg., awarded contr. for bldg. 2 earth dams at Swan Lake (as part of proposed extens. to water works system), at $54,954.

Wash., Seattle—Oregon Boiler Works will probably be awarded contr. for constr. of approx. 900 ft. steel pipe and one Y-connection for Newhalem Crk. Construction plant, at $19,148. Price does not include installation. Contractor located at 3493 Klickitat Ave., Seattle.

Prospective Work

ROADS AND STREETS

Ala., Ashland—Clay Co. Commrs. will construct 17.2-mile road from Ashland to Tuscaloosa Co. line; portion of Ashland-Goowater road, gravel surfacing. Est. cost $363,634.

Cal., Palo Alto—Extensive street paving program authorized by Council: 5-in. conc. pavement with bitum. wearing surface will be laid. Plans and specfs. prepared by City Engr. J. F. Byxbee, Jr. Work as follows: Dist. 1, grading, 3,818 cu. yds.; paving, 199,063 sq. ft.; conc. curbs, 438 lin. ft.; conc. walks, 2,428 sq. ft; storm sewers, 1,005 ft.; 10-in. pipe,; 1,020 ft. 18-in. pipe; 13 catch basins, 7 manholes. Dist 2: Grading, 3,419 cu. yds.; paving, 217,467 cu. ft.; curbs, 3,410 lin. ft.; walks, 1,768 ft.; storm sewers; 460 ft. 10-in. pipe; 460 ft. 12-in. pipe; 460 ft. 14-in. pipe; 710 ft. 16-in. pipe; 10 catch basins; 6 manholes. Dist. 3: Grading, 1,004 cu. yds.; paving, 57,570 sq. ft; walks, 680 sq. ft.; curbs, 2,150 lin. ft.; storm sewers; 275 ft. 10-in. pipe; 460 ft. 16-in. pipe; 50 ft. 18-in. pipe; 75 ft. 21-in. pipe; 6 catch basins; 2 manholes. Dist. 4: Forest Ave. grading, 2,075 cu. yds; paving, 61,218 sq. ft.; curbs, 220 lin. ft.; walks, 1,088 sq. ft.; storm sewers; 245 ft. 10-in. pipe; 1,120 ft. 14-in. pipe; 100 ft. 16-in. pipe; 7 catch basins; 3 manholes.

Cal., San Luis Obispo—Co. Supvrs. have approved plans and specfs. for impvt. of Santa Rosa St.; Monterey northwest to city limits; Sycamore St. Santa Rosa to Hathaway and Hathaway; Sycamore to Murray Ave.; also plans and specfs. for impvt. of road from Cienega road house Cayucos and from Cayucos to Cambria.

Cal., Santa Monica—City Engr. Morton preparing plans and specfs. for paving 7th St.; Colorado to Delaware Ave. Paving in uptown distr. which is estimated to cost abt. $185,000, is contemplated.

Colo., Denver—State Hwy. Dept. plans to pave 1.3-miles of rd. btw. Boulder Creek and Denver, conc. Est. cost $57,000; surface 1.18-mi. Colorado Springs-Canon City Rd., and ¾-mi. Buena Vista Rd., sand. Cost $64,000. Fed. Govt. requested to appropriate toward cost.

Colo., Manitou—Resolution directing Engrs. to prepare full specfs. at once for Manitou Ave. paving project, adopted by Town Board. Petition for grading, curbing and paving filed with Town Bd. showed that 55% of property owners had signed for the impvt. Pavement is 2,700 ft. in length. Welland Engrg. Co. will prepare specfs.

Ga., Atlanta—At general election Council approved extensive street paving projects amounting to $5,000,000.

Ida., Pocatello—Pocatello will spend $873,971 for paving additional streets during the coming Summer.

Ill., Carlinville—Petition for paving Charles St. filed in county court. Est. cost of project, $774,035.

Ill., Marion—Cartersville Twp., Williamson Co., considering constr. of 1½-mi. conc. road, 10 ft. wide, south from Carterville. Plans being prepared. Abt. $50,000. C. M. Sheretz, Marion, Engr.

Ia., Atlantic—Cass County Dist. Engr. making plans for road leading south from Atlantic to Montgomery County line which will be improved with White Pole Rd. from Anita west to Pottawattamie Co. line. C. E. Kringel, Aud.

Ia., Anamosa—City Council has authorized City Engr. to prepare plans for 50 blocks of paving. Work includes relaying part of Main St. and new surf. over macadam on 2nd St.; also all cross streets commencing at Garnavillo and extending to Williams, Davis St., no to Pine, then east to pavement on Williams St., etc. Est. cost of work, $100,000. W. T. Hathaway, City Clk.

Ia., Des Moines—Cities and towns throughout the state are going ahead with plans for enormous amt. of paving during 1921. Not including paving that will be put down under primary road system, programs covering fully 2,000,000 yds. paving in 1921 are already being formulated throughout the state. Contracts for much work have already been let, and many others will probably be awarded during January, February and March. Officials estimate that easily $8,000,000 will be expended next year for city and town paving alone, while in addition more than $1,000,000 a month during pleasant weather will be expended for tiling, grading, graveling and paving on primary road system. 260,000 yds. paving contracts already awarded by city of Des Moines were not completed owing to inability to get materials. This pavement will be put down early in Spring. 300,000 additional yds. will probably be let in near future. 223,000 yds. grading, totaling $180,000 and 95,000 ft. curbing $65,000, have been contracted for and work will be done in Spring. Iowa Hwy. Comn. has fully mapped out plans for impvt. of 6,500 miles rds. in primary rd. sys. and 279 projects have been agreed upon by Comn. Fed. Bureau and Co. Bds. of Supvrs. Plans and specfs. completed for 307 mi. of paving on state roads.

Ia., Silvis—Plans under way for securing bids on paving 5th, 6th and 7th Sts., also 4th Ave. with conc. asph. Other paving jobs are contemplated and these will follow soon after this paving matter is settled.

Ky., Whitesburg—Letcher County has voted in favor of bonds to constr. road system of approx. 200 miles, connecting mountains with Blue Grass region of state.

Md., Baltimore—Paving Comn. will pave 46 blocks of streets in old annex, including Old Frederick Rd., Joseph, Payson, Pulaski and other

BUYERS' GUIDE

Dust Laying Compound.
Barber Asphalt Paving Co.
The Barrett Co.
Sinclair Refining Co.
Standard Oil Co. (Indiana)
The Texas Co.

Edge Protector.
Truscon Steel Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E Mfg. Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling and Harnischfeger.
Sauerman Bros.
Smith Co., T. L. The

Expansion Joint Compound.
The Barrett Co.
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co.

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Sinclair Refining Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Grab Buckets.
Mead-Morrison Mfg. Co.

Graders.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Gravel Screener and Loader.
Good Roads Machinery Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling and Harnischfeger.

Hoists, Electric.
Mead-Morrison Mfg. Co.
Pawling and Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.
Barber Asphalt Paving Co.

Hydrants.
Flower Valve Mfg. Co.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Iron Fence.
Cincinnati Iron Fence Co.

Joint Fillers (Paving).
The Barrett Co.

Kettles (Portable).
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Company.
Lakewood Engineering Co.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Diamond T Motor Car Co.
Federal Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co., The
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry.

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros Co.

Paving Joint Compound.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.

Paving Joint Filler.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Smith Co., T. L. The
Warren Bros. Co.

Pipe Cutters.
W. W. Strickler & Bro.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Cach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Pumps.
C. H. & E. Mfg. Co.
De Laval Steam Turbine Co.
Harris Air Pump Company.
Smith Co., T. L., The

Reinforcing For Pavements.
American Steel and Wire Co.
Truscon Steel Co.

Road Building Material.
Barber Asphalt Paving Co.
Kentucky Rock Asphalt Co.
Sinclair Refining Company.
The Texas Co.

streets and avenues; sheet asph. decided upon for paving Pratt St., Bway., etc. State Rds. Comn., 601 Garrett Bldg. plans 2 miles conc. paving in various counties. Will advertise for bids in Spring.

Mass., Boston—City considering bldg. new roadway and entrances to Franklin Park at Forest Hills and Morton Sts. Abt. $40,000; also conc. walks in and around Boston Common, Boylston and Tremont Sts. Abt. $30,000. J. J. Murphy, 33 Beacon St., Archt.-Engr. City (Dorchester) also plans to build Columbia Rd. betw. Ed Everett Sq. and Carsen St., bitum. macadam. Abt. $30,000.

Mich., Eagle River—Survey completed for new highway from Gay to Lake Linden, Keweenaw Co. 7 miles long. Wm. R. Bennetts, Co. Aud.

Mich., Grand Rapids—Kent Co. road commission has taken over main streets of Sparta, Caledonia and Lowell and preparation is under way for laying conc. pavements early in Spring. County will bear 25% of estimated $50,000 cost, state providing the remainder.

Mich., Grand Rapids—F. E. Stattuck, Pres. Sand Lake Village, has requested Kent Co. Rd. Comn. to hasten work of completing the paving of Main street of village to make it part of the Mackinaw trail.

Minn., Red Lake Falls—Red Lake County will gravel and improve 2 new state roads; one from Wylie Village to intersect. of State Rd., 6.2 mi. long, and the other near Plummer Rd. south of Polk Co. line, 7 mi. long. Geo. Dupont, Co. Aud.

Mo., Springfield—State Hwy. Dept. plans to construct 7 mile road from Mills Corner to Lawrence Co. line; $35,000; 9½ miles of road from James River Bridge south of Springfield to Rogersville, $97,000.

Minn., St. Cloud—Hwy Engrs. M. J. Cleveland and C. H. West, St. Cloud, are making prelim. surveys east and west of Sauk Center on roads to Little Falls and Glenwood; also road betw. Kimbal and St. Cloud. Will gravel in spring. F. Borgman, St. Cloud, Commr. Searns County.

Mo., Ozark—State Hwy Dept. Jefferson City, will construct 31½ miles of road from Christian Co. line near Republic to Webster Co. line. Est. cost $243,000.

Mont., Helena—State Highway Comn., John N. Edy, Chf. Engr., announced that work will start soon on 71 projects in 32 counties representing 560 miles of road; 26 bridges. Total est. cost $5,505,245. Work includes following: Earth and roadside material; grading projs., 174 miles; gravel and macadam surf. projects, 354 miles; bitum. conc. paving, 1 mile; Portland cem. conc paving, 29 miles.

Neb., Holdrege—Council has created 5 new paving districts. Includes East and West Avenues, north from present paving to 14th Ave.; Garfield and Grant Sts., from Railroad to 11th Ave.; 14th Ave. and Lincoln St. and 4th Ave. to city limits. Will ask bids in Spring. W. Lindstrom, City Clk.

Neb., Ord—Plans being completed for 80 addn. blocks of paving for 1921. W. E. Waters, Clk.

N. J., Redbank—Monmouth County Bd. of Freeholders will expend $440,000 this Spring for paving 4 miles of road betw. Long Branch and Ashbury Park. C. D. Cooper, Red Bank, Engr. in charge.

N. D. Jamestown—City Engr. instructed to prepare plans and specifications for three large paving projects for next year. Bithulithic, cement and asphalt will be considered.

O., Cincinnati—Street impvts. to cost more than $1,000,000 will begin as soon as weather permits. Several sewer impvts., including installation of sewers in Madisonville, are incorporated in estimates for the impvts.

O., Columbus—Paving program outlined by city officials will cost taxpayers about $1,300,000.

O., Columbus—Estimated assessments for proposed paving of 3rd St., Livingston Ave. to Naughten St., presented by City Engr. Simpson to Council. Est. cost $213,775. Council has requested him to estimate cost of improving Neil Ave., Goodale St. to 11th Ave.

Okla., Dewey—City will grade and pave 15½ blocks of streets; 24 and 30 ft. wide; 16,130 sq. yds. conc.; 10,300 lin. ft conc. curbing. Will ask bids in Spring. Wood & Witten, Engrs., Tulsa.

Okla., Duncan—City Comns. have decided to proceed with prelim. in connection with proposed extensions of pavement on Main St. Present paving project involves 50 blocks.

Okla., Hartshorne—Prelim. plans prepared by V. V. Long and Co., Engrs., Colcord Bldg., Okla. City, for paving Dist. 3, involving 15,000 sq. ft. of conc. Abt. $75,000.

Okla., Weatherford—City will pave 13 blks. of street; $181,000 available. Eugene Forbes, Mayor. Bids will be asked in Spring. V. V. Long & Co., Engrs., Okla. City.

Tex., Amarillo—Potter Co. Commrs. will improve Ozark Trail, St. Francis and Washburn Roads. $1,000,000 available. A. T. Dickek, Res. Engr.

Tex., Dallas—100 streets are to be paved here as soon as possible. Conditions such that since May 1st little has been accomplished, but during this month conditions have changed, and the work will continue at an accelerated rate.

Tex., Cleburne—Johnson Co. Commrs. will grade and surf. 25 mi. Hwy. No. 2-A, thru Burleson, Grendiew, etc., gravel rd. 16 ft. wide with rein. conc. and steel bridges & culverts; date of opening bids not determined. $610,000 available; $200,000 Fed aid. R. O. Whiteaker, Co. Engr.

Tex., Georgetown—Williamson Co. Commrs., F. D. Love, Judge, will construct 11.3 mi. bitum.-topped road on Hwy. No. 2; $70,329. R. A. Nicholas, Co. Engr.

Va., Roanoke—City will construct 100,000 sq. yds. paving, penetration macadam, sheet asph. brk. and granite block. $300,000 available. A. W. Morris, City Engr.

Wash., Hoquiam—Every effort will be made by Olympia Peninsula Hwy. Develop. Assn. to complete missing link in Olympia Hwy. at an early date. Plans of executive members provide for constr. of temporary rdway. from present terminals of highway at The Forks and Lake Quinault. Rd. though temporary, will be built on permanent location, have perm. brdgs., would not be graveled except in occasional stretches and not graded to full extent. Planking would be provided where necessary. Cost of constr. such a road is est. at about $1,250,000. With money which legislature is expected to appropriate, bldg. will start from both ends of hwy.

Wis., Balsam Lake—Co. Bd. of Polk Co. has voted $10,000 for purchase of road machinery, including two screening plants and possibly two trucks. C. W. Nystrom, Balsam Lake, Commr.

Wis., Fond du Lac—Hwy. bldg. program for Fond du Lac Co. for next year calls for total expendt. of more than one million dollars. Conc. will be used on roads.

Wis., Chippewa Falls—Chippewa Co. Bd. of Supvrs. appropriated $8,000 for purchase of rd. machinery for 1921 rd constr. and maint. P. O. Lokrantz, Chippewa Falls, Commr.

Wis., Washburn—Bayfield Co. contemplates permanent trunk hwy. on old grade of Peerless railroad, Washburn-Ashland Hwy., west to Moquah, thence to Iron River, to connect with Superior-Duluth State Hwy. J. H. McLean, Madison, Wis., Hwy. Commr. Est. cost $250,000.

SEWERAGE AND SEWAGE TREATMENT.

Fla., Pensacola—Ord. introduced at meeting of Commrs., provides for relaying what is known as the DeViller St. sewer from Chase to Main Sts. Work will cost abt. $20,000.

Fla., W. Palm Beach—City will construct sewers and drains during next year costing $150,000. Carl Riddle, City Mgr.

Ill., Chicago—Council Streets & Alleys Comm. has approved a $223,999 sewer system for Englewood District. Sewer is to be T-shaped and will extend beneath Wentworth Ave. from Garfield Blvd. to 63rd St. and under 63rd St., Harvard to State St.

Ia., Spencer—Preliminary steps toward constr. of sewage disp. plant here are being taken by city officials, in compliance with an agreement with State Bd. of Health. Prof. J. H. Dunlap, head of Dept. of Sanitation engineering college at University of Iowa is looking over the ground in connection with the plans. H. C. McKean, City Engr.

Ia., Ames—City will open bids in Feb. for bldg. sewage disp. plant and outfalls., to include mains, tank and pumping station. Est. cost abt. $125,000. P. F. Hopkens, Ames, Engr.

Ia., Charles City—Cons. Engr. W. E. Buell, 228 Davidson Bldg., Sioux City, completing plans for disp. plant. J. W. McGeeney, City Clk.

Mass., N. Chelmsford—Town considering bldg.

BUYERS' GUIDE

Road Binder.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Sinclair Refining Company.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Lakewood Engineering Co.
Mayer, F.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co., The
American Road Plane Co.

Road Oil and Preservatives.
Barber Asphalt Paving Co.
The Barrett Co.
New Orleans Refining Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.
Good Roads Machinery Co., Inc.

Road Tampers.
Lakewood Engineering Co.

Rock Crushers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Roofing Material.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.
Warren Bros. Co.

Sand Dryers.
Cummer & Son Co., The F. D.

Saw Rigs.
C. H. & E. Mfg. Co.

Sandstone.
Cleveland Stone Co.

Scarifiers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Drag Line.
Pawling and Harnishchfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Power.
Sauerman Bros.

Sewage Treatment.
Direct Oxidation Process Corp.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.
Clay Products Association.

Sewer Rods.
Stewart, W. H.

Sidewalks (Stone).
Cleveland Stone Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Machinery Corporation.
Good Roads Machinery Co., Inc.

Special Castings.
Crane Co.
Flower Valve Mfg. Co.
U. S. Cast Iron Pipe & Fdy. Co.

Sprinklers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
Austin-Western Road Machinery Co., The

Stone Curbing.
Cleveland Stone Co.

Stone Elevators.
Austin-Western Road Machinery Co., The

Stone Flagging.
Cleveland Stone Co.

Stone Spreaders.
Austin-Western Road Machinery Co.
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co.

Street Crossings.
Cleveland Stone Co.

Street Flushers (Horse Drawn).
Austin-Western Road Machinery Co.

Street Paving Material.
Barber Asphalt Paving Co.
The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Co., Ltd., The

Structural Steel.
Lewis-Hall Iron Works.

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.
Elgin Sales Corp.

Tamping Machines.
Pawling and Harnischfeger.

Tanks, Water Supply.
Mensch, L. J.

Tar and Pitch.
The Barrett Co.
Philip Carey Co., The

Tar Heaters.
Littleford Bros.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith.
Walter H. Flood.
Howard, J. W.
Kirschbraun, Lester.
Van Trump, Isaac.

Traction Engines.
Austin-Western Road Machinery Co.

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

Tractors.
Austin Machinery Corporation.
Carl Heim.

Trench Braces.
Kalamazoo Fdry & Mich. Co.

Trench Machinery.
Austin Machinery Corporation.
Kalamazoo Fdy. & Machine Co.
Pawling and Harnischfeger

Trinidad Lake Asphalt.
Barber Asphalt Paving Co.

Turbines, Steam.
De Laval Steam Turbine Co.

Valves.
Coldwell-Wilcox Co.
Flower Valve Mfg. Co.

Wall Coping.
Cannelton Sewer Pipe Co.

Warranite.
Warren Bros. Co.

Water Main Cleaning.
National Water Main Cleaning Co.

Water Pipe.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau

Waterproofing.
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.
The Texas Co.
Truscon Steel Co.

Water Purification.
Direct Oxidation Process Corp.
Pennsylvania Salt Mfg. Co.

Water Softener.
The Refinite Co.

Water Works Supplies and Equipment.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau.
Coldwell-Wilcox Co.
Flower Valve Mfg. Co.
Pennsylvania Salt Mfg. Co.

Wheeled Scrapers.
Austin-Western Road Machinery Co.

Winches, Vertical Capstan or Friction Drum.
Mead-Morrison Manufacturing Co.

Wire Rope.
American Steel & Wire Co.

Windows (Steel).
Truscon Steel Co.

Wire-Cut Lug Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
Springfield Paving Brick Co.

Wood Block (Creosoted).
Barrett Co., The
Republic Creosoting Co.

Wood Preservatives.
Barrett Co., The
Republic Creosoting Co.

vitr. sewers in several streets. Est. cost $25,000. Archt. not selected.

N. C., Idlewild—Bldg. 1½ mi. sewers and½ mi. water mains at cost of $15,000 is contemplated. J. B. Bray, City Engr.

O., Lima—Fuller and McClintock, New York City, retained by City to prepare plans and ests. for new intercepting sewer system here. Est. cost of new system $1,250,000. Elmer McClain, Serv. Director.

O., Lorain—City Engr. C. O. Miller, making survey of sewerage system on east side of City with view to amalgamating system with that on west side where sewage disp. plant will eventually be erected. Ord. will be presented to Council authorizing City to borrow $5,600 to finance installation of sewers in Ashland Ave. and E. 22nd St. City Aud. C. L. Patterson.

O., Silver Lake, (Cuyahoga Falls, P. O.)—Village plans to construct sewer in Hastings Ave., involving 2,100 ft. 8-36 in. vitr. pipe. Abt. $22,000. E. A. Thewksbery, Clk. C. W. Courtney, Leader-News Bldg., Cleveland.

O., Toledo—City expects to let contracts next Spring for bldg. sewage disp. pumping station on island in Bayview Pk. Funds for the work is anticipated thru sale of $1,000,000 intercepting sewer bonds, approved by Finance Comm. of Council.

Okla., Okla. City—Consulting Engrs. are preparing plans for sewage purifying plant. Plans may be completed within 60 days. Plant is to form part of a plan for straightening river channel, and provisions will be made for diversion of storm sewers from old river channel to new canal.

Pa., Easton—City considering constr. of sewerage system and sewage disp. plant. Abt. $3,500,000. Hill & Ferguson, 112 E. 19th St., New York City, Engrs.

Pa., Scranton—Dept. Public Works will receive bids in Spring for bldg. lateral sewers, involving 3,550 lin. ft. 8-20 in. vitr. pipe sewer. Abt. $27,701. W. A. Schunk, Chf. Engr.

S. C., Greenwood—City, A. M. D. Singleton, Treas., will construct sewer and streets. $200,000 bonds to be issued.

Tex., Dallas—Plans and specfs. being prepared for $200,000 storm sewer on Pacific Ave. Present plans call for sewer more than a mile long extending from Preston St. to river. Sewer will be 30 ins. in diam. at beginning, gradually becoming larger until at river the diam. will be 90 inches. Portion betw. Preston and Emma Sts. will be constr. of conc. pipe cast before laying in ground.

Wis., Ellsworth—City had prelim. plans prepared for furnishing material, excavating and laying 2 miles sewers in Main St., et al, involving 25,000 ft. 8,015 ft. vitr. pipe. Abt. $50,000. Druar and Milenowski, Globe Bldg., St. Paul, Cons. Engrs.

WATER SUPPLY AND PURIFICATION.

Ark., Judsonia—Ark. Hydro-Elec. Develp. Co., R. R. James, Pres., Cotton Plant, Ark., has increased capital from $500,000 to $3,000,000. Will construct hydro electric plant on Little Red River; constr. in Spring. J. E. Sirrine, Cons. Engr., Greenville, S. C.

Ariz., Phoenx—$450,000 bonds voted here for extensions and impvts. to city water distribution system.

Cal., Santa Ana—City considering constr. of reservoir on Santiago Crk., involving construction of conc. dam, 100 ft. high which will impound 7,000,000,000 gal. of water. Cost to exceed $50,000. W. H. Hoy, Santa Ana, Engr.

Ont., Brockville—Provincial Bd. of Health, Toronto, has authorized constr. of filtration plant here. Abt. $50,000.

Ont., London—Pub. Utilities Comm. plans to expend $135,000 for extensions to water distribution system; work involves cast iron pipe, mains, hydrants, etc. E. V. Buchanan, Hydro Bldg. Engr.

Ont., Ottawa—City is applying to Legislature for permission to borrow $40,000 for water meters, $100,000 for extension to water mains, $50,000 for buying and installing hydrants.

Ont., Port Credit—Council will soon ask bids for bldg. water works system. Abt. $150,000.

Ont., St. Thomas—Bd. Water Commrs. contemplate constr. of conc. dam across Kettle Creek and impvt. of present water works system. Project will involve abt. $230,000.

B. C., Vancouver—Nearly 4,000 ft. steel water mains, costing $51,000, are to be laid in business sections of this city. City Engr. F. L. Fellowes.

Washington, D. C.—Dist. Commrs., M. C. Hargrove, Purchasing Agt., 320 Dist. Bldg., contemplate extending water mains and installing fire hydrants. $315,000.

Ga., Atlanta—City considering improving water works. May issue $3,000,000 bonds. Norcross & Kreis, Engrs. W. E. Dunn, Chrmn.

Ill., Hanover—City will receive bids about Feb. 1, for impvt. of water works system, to include deep well, pumphouse, pump, elevated tank and water distribution system. Abt. $30,000. Holland, Ackerman & Holland, Ann Arbor, Cons. Engrs.

Ill., Pana—$100,000 will be expended here in the Spring for enlarging reservoir of water works and increasing water supply.

Ia., Newton—City had plans prepared for bldg. rein. conc. or steel reservoir with 1,250,000-gal. capy., 2 centrif. pumps, pump house, 20-35 h. p. motor to pump 350,000 gal. per min., etc. Work involves 1,000 cu. yds. conc. in reservoir and 3,250 cu. yds. earth excav. Abt. $65,000. E. T. Archer, New England Bldg., Kansas City, Mo., Engrs.

Ia., Sioux City—City will improve water works system. Will lay 10,000 ft. 24-in. mains in Spring. Phil Carlin, Supt. Water Wks.

Kans., Leavenworth—Vote cast in favor of taking over water works plant at purch. price of $650,000. Burns & McDonnell, Kansas City, Mo., have prepared plans for impvts.

Mich., Owosso—$58,400 bonds sold for purpose of extending water mains.

Miss., Winona—$60,000 bonds voted to purchase water and light plant. J. O. Staples, Mayor.

Mo., Eminence—Western Tie & Timber Co., St. Louis, will build hydro-elec. plant on Current River; transmission line to Poplar Bluff; constr. steel tower and other facilities betw. power plant and Poplar Bluff; dist. 75 miles. Cost betw. $350,000 and $400,000.

Neb., No. Platte—City will make $50,000 impvts. on water works system and $10,000 for fire station. O. E. Elder, City Clk.

N. H., Milford—Plans being prepared for big filter plant. All ests. and plans will be made this Winter and constr. on large filter beds will be started as soon as possible in Spring.

N. Y., Mt. Vernon—City having plans prepared for transmission main from reservoir at Hillview to here. Abt. $300,000. Hill and Ferguson, 112 E. 19th St. N. Y. City, Engrs.

O., Cleveland—First definite steps to extend sewer and water mains to unincorporated areas of county, taken when Co. Commrs. established san. engrg. dept. Two dists. created, embracing area of abt. 27,000 acres and comprising sects. of Brooklyn Heights, Parma, Middleburg, Independence and Brookpart, lying with watershed of Big Crk., and along watershed of Cuyahoga River. Other dists. are to be created soon as these are completed to provide water and sewer facilities to practically the entire unincorporated area of county. Recent prelim. survey placed cost of systems in the 2 dists. at abt. $5,000,000.

S. D., Yankton—City voted in favor of $70,000 bond issue for developing system to provide city with Missouri river water, secured thru wells and intakes in piers of Meridian Hwy. bridge. Jno. W. Summers, Clk.

Tex., Port Arthur—$2,000,000 bonds voted for following work: Convey water from Sabine River; install intake, including open ditch for 16 3-5 miles on Sabine River, 10 miles above Orange, near Kansas City Southern R. R. crossing; install 2 pumping plants, settling basin and cem. aqueduct from Port Neches. Nagle, Witt-Rollins Engr. Co., Engrs., Dallas, Texas.

Tex., Ennis—City considering purchase of machine for purification of lake water by liquid chlorine.

Wis., Racine—City plans to improve and bldg. extensions to water works system. Abt. $1,936,000. P. H. Connolly, City Engr.

Wis., Viroqua—$40,000 bond ordinance passed by Council to enlarge, extend and improve water works by additional wells, reservoirs, pipes, pipelines, machy. and equipt. W. G. Kirchoffer, Madison, Wis., engr., will probably prepare plans. E. J. Older, Clk.

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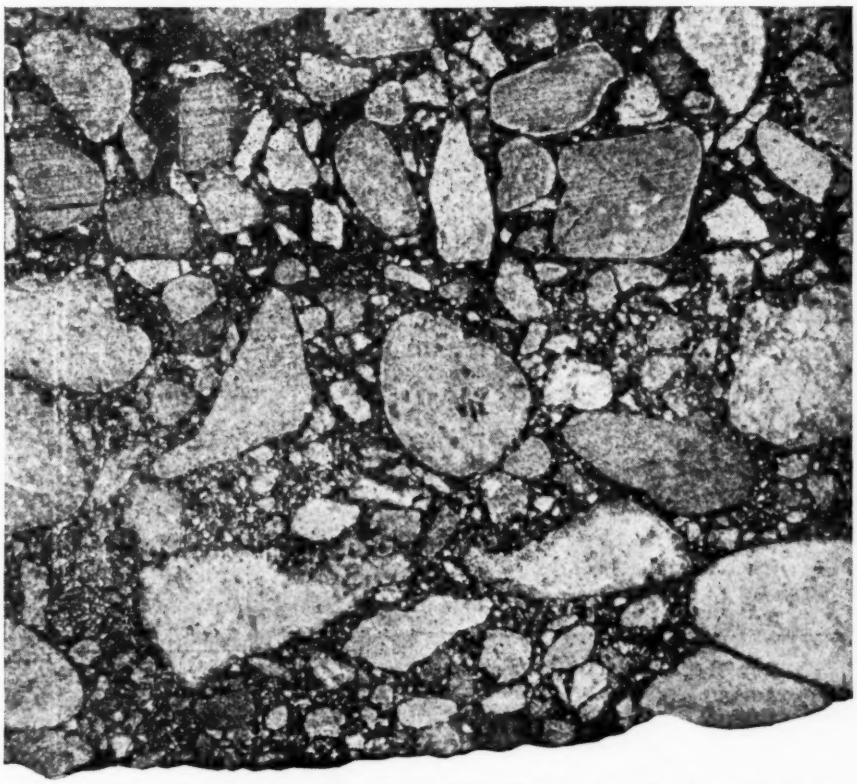

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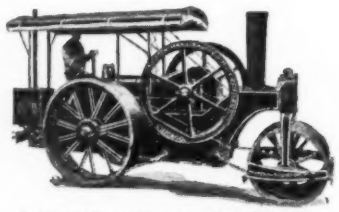

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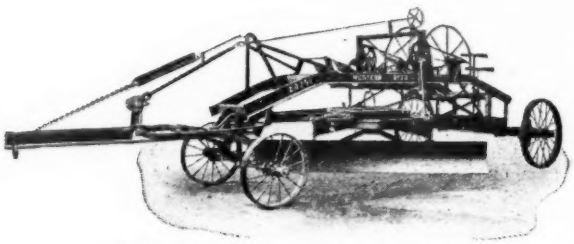

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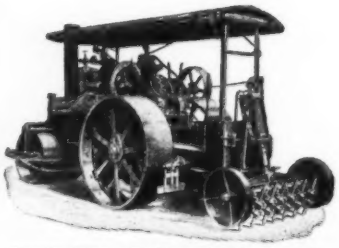

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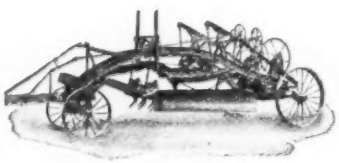

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